The 288P (300163) binary asteroid system is unique and puzzling for its unusual combination of properties. It combines a wide separation with near-equal component sizes, and a high eccentricity with alignment of the mutual and heliocentric orbital planes. In addition, it is one of five known active asteroids with sublimation-driven dust production. Orbital fits to high-resolution data obtained in Cycle 24 are inconclusive regarding the orbital period and therefore the total angular momentum content, crucial to discriminate between formation of the binary system via rotational fission or impact. We request five orbits of HST/WFC3 time to measure the time evolution of the component separation under the favourable viewing geometry along the system's minor axis around the perigee passage in December 2017, to constrain with high certainty the orbital period and eccentricity of the system, and therefore its total angular momentum content. This is crucial to discriminate between the two formation scenarios and to understand the connection between the activity and the binary nature. As 288P is heading towards aphelion, the next opportunity to resolve its components will be in 2021.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Stellar Physics  
ID: 15090  
Program Title: A UV spectroscopic survey of periodic M dwarfs in the Hyades

Principal Investigator: Marcel Agueros  
PI Institution: Columbia University in the City of New York

Because of its proximity, the 650-Myr-old Hyades open cluster is a unique resource for exploring the relationship between magnetic activity, rotation, and age in low-mass stars. While the cluster has been largely ignored in UV studies of the dependence of activity on rotation, we now have an extensive and growing set of complementary rotation period, Halpha, and X-ray measurements with which to examine in detail the rotation-activity relation at 650 Myr and to constrain theories of magnetic heating. We propose to measure Mg II line emission, the strongest NUV activity tracer, in COS spectra of 18 Hyads ranging in spectral type from M0 to M7 with known rotation periods and Halpha and X-ray measurements. These stars form a representative sample of M-dwarf Hyads with known periods and are a significant addition to, and expansion of, the sample of 20 mainly solar-mass rotators with existing (mostly low-resolution) IUE NUV spectra. The Mg II measurements will contribute significantly to our goal of mapping out the rotation-activity relation star-by-star in this benchmark open cluster. This, in turn, will move us toward an improved understanding of the radiation environment and habitability of the exoplanets we continue to find around low-mass stars.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: SNAP  
Scientific Category: Stellar Physics  
ID: 15091  
Program Title: A UV spectroscopic snapshot survey of low-mass stars in the Hyades

Principal Investigator: Marcel Agueros  
PI Institution: Columbia University in the City of New York

Because of its proximity, the 650-Myr-old Hyades open cluster is a unique resource for exploring the relationship between magnetic activity, rotation, and age in low-mass stars. While the cluster has been largely ignored in UV studies of the dependence of activity on rotation, we now have an extensive and growing set of complementary rotation period, Halpha, and X-ray measurements with which to examine in detail the rotation-activity relation at 650 Myr and to constrain theories of magnetic heating. We propose to measure Mg II line emission, the strongest NUV activity tracer, in COS spectra of 86 Hyads ranging in spectral type from G2 to M4 with known rotation periods or currently being observed by K2. These stars form a representative sample of low-mass Hyads with known periods and are a significant addition to, and expansion of, the sample of 20 mainly solar-mass rotators with existing (mostly low-resolution) IUE NUV spectra. The Mg II measurements will contribute significantly to our goal of mapping out the rotation-activity relation star-by-star in this benchmark open cluster. This, in turn, will move us toward an improved understanding of the radiation environment and habitability of the exoplanets we continue to find around low-mass stars.
Interstellar dust grains play a critical role in the formation of stars, and significantly impact the evolution and appearance of distant galaxies. High redshift studies must account for this dust. Dust grains in the Milky Way are predominately carbonaceous and silicate, each of which produces unique spectral signatures in the extinction curve. In distant galaxies, the composition of dust grains and the relative amount of silicate and carbonaceous dust can be studied using the extinction curves along luminous background quasar sightlines produced by gas-rich foreground absorbers. Our previous work suggests that dust grains in distant galaxies are often more silicate-rich than in the Milky Way, but that the dust may be predominately silicate or carbonaceous along a sightline. We predict that silicate-poor, dusty DLAs should be rich in carbonaceous dust, and exhibit a relatively strong 2175 Å bump. To test this hypothesis, we propose G230L/430L STIS spectra covering the 2175 Å bump in the dusty z=0.437 DLA toward 3C 196, which is hosted in a barred spiral galaxy with (super-) solar metallicity. We expect to find a significant 2175 Å bump in this system, like in the dusty but silicate-poor z=0.524 DLA toward AO 0235+164. Combining the proposed data with archival spectra will yield an extinction curve extending from the FUV to the IR, for comparison with local galaxies. The results of this test will significantly inform our models about the distribution of dust grain populations and the dichotomy between carbonaceous and silicate dust grains, and address whether moderate redshift dust in spiral galaxies does differ from the Milky Way, in preparation for planned JWST studies.
Measuring galaxy metallicity with cosmic time is of paramount importance to understand galaxy formation. ISM abundances are typically determined using emission-line spectroscopy of HII regions. However, HII regions may be self-enriched and not typical of the whole galaxy. This is particularly true for star-forming galaxies (SFGs) where the bulk of metals may be in the neutral gas. Quantifying metals in the ISM is thus important to assess how reliably HII regions trace galaxy abundances at any redshift. We were awarded 34 HST orbits (Cycle 17) to measure abundances in the neutral ISM of 9 nearby SFGs using absorption lines in the COS G130M/1291 spectra of bright UV background sources within the galaxy itself. We found metallicities that differ by up to ~ 2 dex depending on the element. These variations could be real or due to observational effects. Here we request 22 orbits in the new G130M/1222 and in G160M/1623 to access new FUV spectral transitions that will help us characterize ionized-gas contamination and dust depletion, and ultimately nail down the abundances of the different elements. These new data will nicely complement our Cycle 17 COS and Gemini/GMOS IFU programs, the latter aimed at deriving nebular abundances along the same COS sightlines. This first detailed and spatially-accurate comparison between neutral- and ionized-gas abundances in local (z~0) SFGs will provide crucial insights into the metallicity of galaxies at any redshift. If this UV spectroscopic study is not undertaken before HST ceases operation, the (in)homogeneity of the ISM in galaxies of the local Universe will continue to remain uncertain for at least another decade.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Stellar Populations  
ID: 15194  
Program Title: The Epoch of the First Star Formation in the Closest Metal-Poor Blue Compact Dwarf Galaxy UGC 4483

Principal Investigator: Alessandra Aloisi  
PI Institution: Space Telescope Science Institute

Metal-poor Blue Compact Dwarf (BCD) galaxies have been interpreted as nearby galaxies "in formation". This view has been challenged by HST detection of Red Giant Branch (RGB) stars in all metal-poor BCDs where an RGB tip (TRGB, brightest RGB phase) has been searched for, implying the presence of stars at least ~ 1 Gyr old. Due to the age-metallicity degeneracy, the RGB color provides little insight into the exact star formation history (SFH) beyond 1 Gyr. So, the first SF epoch may have occurred anywhere between ~13 and 1 Gyr ago. To resolve this, it is necessary to reach features in the color-magnitude diagram (CMD) that are much fainter than the TRGB. Here we propose new WFC3/UVIS observations (with ACS/WFC in parallel) of the closest metal-poor BCD, UGC 4483. These data will yield an I vs. V-I CMD that goes ~ 4 mag deeper than the TRGB allowing to detect red clump (RC) and horizontal branch (HB) stars. Variable stars of RR Lyrae type will also be detected. With their mere presence, these variables will indisputably prove the existence of a population at least ~ 10 Gyr old. Apparent mag and width of RC, HB and RGB will independently constrain age and metallicity of the old/evolved stars, the presence of multiple SF episodes, their duration and metallicity spread. This deep crowded-field photometric project is only possible with HST. Due to UGC 4483 location in CVZ, it can be done in half the number of orbits that it would otherwise take. Since UGC 4483 is so close, it may be the only BCD for which these questions can be answered in the near future. It provides our best chance for learning about the true cosmological age and evolutionary state of these enigmatic galaxies.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Stellar Physics  
ID: 15299

Program Title: Weaving the history of the solar wind with magnetic field lines

Principal Investigator: Julian Alvarado Gomez  
PI Institution: Smithsonian Institution Astrophysical Observatory

Despite its fundamental role for the evolution of the solar system, our observational knowledge of the wind properties of the young Sun comes from a single stellar observation. This unexpected fact for a field such as astrophysics arises from the difficulty of detecting Sun-like stellar winds. Their detection relies on the appearance of an atmospheric signature (from the stellar wind-ISM interaction region), visible only with the aid of high-resolution HST Lyman-alpha spectra. However, observations and modelling of the present day Sun have revealed that magnetic fields constitute the main driver of the solar wind, providing guidance on how such winds would look like back in time. In this context we propose observations of four young Sun-like stars in order to detect their atmospheres and characterise their stellar winds. For all these objects we have recovered surface magnetic field maps using the technique of Zeeman Doppler Imaging, and developed detailed wind models based on these observed field distributions. Even a single detection would represent a major step forward for our understanding of the history of the solar wind, and the outflows in more active stars. Mass loss rate estimates from HST will be confronted with predictions from realistic models of the corona/stellar wind. In one of our objects the comparison would allow us to quantify the wind variability induced by the magnetic cycle of a star, other than the Sun, for the first time. Three of our targets are planet hosts, thus the HST spectra would also provide key information on the high-energy environment of these systems, guaranteeing their legacy value for the growing field of exoplanet characterisation.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Stellar Populations  
ID: 15093  
Program Title: Dwarfs and Giants: Massive Stars in Little Dwarf Galaxies

Principal Investigator: Jennifer Andrews  
PI Institution: University of Arizona

Dwarf galaxies are sensitive laboratories for testing theories of star formation and for investigating possible variations of the stellar Initial Mass Function (IMF). Establishing whether the IMF, in particular the upper end of the IMF (uIMF), is invariant or dependent upon the conditions of star formation is key for interpreting the vast majority of observations on galaxy evolution, and for understanding cosmic reionization. Low-metallicity dwarf galaxies are fairly isolated systems that are ideal locales to test the uIMF. We propose to obtain STIS UV/optical spectroscopy of 8 H-alpha bright stellar clusters in 4 dwarf galaxies within 3 Mpc to accurately determine their ages, masses, extinction, metallicity, and stellar content. We will use state of the art stellar synthesis models that include massive star specific evolutionary tracks, massive star rotation, and stochasticity to test whether dwarf galaxies really do have a top-light IMF. The success of this project relies on the spectroscopic UV capability of HST/STIS to isolate young compact star clusters and break the degeneracies between reddening and age.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category:  GO  
Scientific Category:  Stellar Physics  
ID:  15222  
Program Title:  What Type of Star Made the One-of-a-kind Supernova iPTF14hls?

Principal Investigator:  Lair Arcavi  
PI Institution:  University of California - Santa Barbara

iPTF14hls is an ongoing nearby supernova with spectral features identical to those of the common Type IIP class but more slowly evolving, remaining luminous for over 600 days with at least five distinct peaks in its light curve and showing evidence for multiple pre-explosion eruptions. The observed properties of iPTF14hls are unique among all known supernovae, challenge all existing explosion models and likely indicate pre-explosion eruptions with time scales and energies never observed before. Such eruptions are theorized to occur in ~95-130 solar mass stars which experience the pulsational pair instability. If iPTF14hls is indeed the first observed case of such a supernova, then determining its progenitor mass and metallicity will provide the first observational constraints of stellar evolutionary models in these mass ranges. Since no pre-explosion high-resolution imaging of the location of iPTF14hls exist, the only way to constrain the progenitor properties (independent of the supernova) is through HST studies of the site after the event fades. Such studies will require knowing the position of iPTF14hls to few-parsec precision. We propose a single-orbit HST observation to obtain high resolution localization of iPTF14hls before it fades. These images will serve as registration anchors for future post-event observations at the required precision (not possible with ground-based AO imaging). These observations will also allow us to measure the very late-time decline rate of iPTF14hls, constraining possible power sources, and to test an alternative explanation for iPTF14hls as a lensed normal supernova, by constraining any departure from point-source emission.
Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15223
Program Title: The Brightest Galaxy-Scale Lens

Principal Investigator: Matthew Auger
PI Institution: University of Cambridge

We have very recently discovered the brightest galaxy-scale lens known to date \((r = 18.7\)\). This system is ideally suited for spatially resolved studies of the source galaxy at a redshift \(z = 2.8\), i.e., the peak epoch of star formation. Such bright galaxy-scale lenses are key to constraining the evolutionary processes which take place at these redshifts owing to their high magnifications and simple lensing mass distributions; furthermore, they allow an extremely sensitive probe of dark substructures within the lensing galaxy. The requested deep, high-resolution imaging will be used to robustly infer the lensing potential and 'de-lens' the galaxy to probe its structure on scales as small as \(~20\) pc, and will greatly facilitate future spectroscopic observations with, for example, JWST.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15300
Program Title: Ecliptic-poles Stellar Survey (EclipSS)

Principal Investigator: Thomas Ayres
PI Institution: University of Colorado at Boulder

BACKGROUND: Now and in coming years, a number of orbiting observatories will be scanning the skies for astrometry (Gaia), transiting exoplanets (TESS), and high-energy sources (eROSITA). A key characteristic of these surveys is their high degree of exposure in the ecliptic polar regions, north and south; a natural consequence of their preferred scanning orientation. Further, JWST, although not a scanning instrument, also holds the ecliptic poles in special regard because they are accessible at all times ("continuous viewing zones"), a key advantage for exo-planet studies.

THIS PROPOSAL: Record FUV spectra, with COS G130M, of a well-defined sample of sunlike dwarfs (F2V-K2V) at the ecliptic poles to take advantage of the enhanced, wholistic information concerning rotation periods, sizes, masses, metallicities, ages, activity levels, and coronal properties that will be available for bright e-polar stars over the next few years. There is a sweet spot at about 8th magnitude where sunlike stars are not too bright for TESS, bright enough for eROSITA, and just right for COS. The G130M channel captures a wide range of ionization states, especially of Si, N, O, and C; the hydrogen Lyman-alpha emission; and also coronal forbidden transitions of Fe XII (124 nm) and Fe XXI (135 nm); altogether reflecting gas temperatures from 10,000 K to 10 MK in the magnetically disturbed stellar outer atmospheres. The combined photometric (starspots), asteroseismic, FUV, and X-ray measurements will inform community-wide efforts to explore stellar activity and its underlying magnetic machine, the Dynamo. This is a unique opportunity, and one -- like a solar eclipse -- too good to pass up.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15160
Program Title: High-resolution imaging of four lensed dusty star-forming galaxies

Principal Investigator: Andrew Baker
PI Institution: Rutgers the State University of New Jersey

Dusty star-forming galaxies (DSFGs) make significant contributions to the star formation history of the universe, but the same dust that powers their luminosity obscures much or all of the rest-UV and optical light that would allow easy study of their dynamical properties and evolutionary states. In this proposal, we request observations of four DSFGs that are among the brightest point sources in three-band mapping with the Atacama Cosmology Telescope (ACT), all of which show incontrovertible evidence of gravitational lensing. From HST imaging, we will extract information about the background sources and lens-plane structures and develop gravitational lens models, thereby gaining insights into the DSFGs' intrinsic sizes, morphologies, and gas masses and kinematics, and into the presence of substructure in the lens plane. This effort will be strengthened by the fact that three of our four targets already have highly resolved mid-J CO mapping with the IRAM Northern Extended Millimeter Array; in these cases, each independent velocity channel serves as an independent probe of the lensing potential.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Massive Black Holes And Their Host Galaxies
ID: 15224
Program Title: The host galaxy and environment of a bright QSO at z=7.54

Principal Investigator: Eduardo Banados
PI Institution: Carnegie Institution of Washington

After almost a decade of intense search, our team has finally discovered a bright QSO well within the epoch of reionization, at z=7.54. This is by far the most distant QSO known (previous record: 7.08), at a cosmic age of 690 Myr, i.e., only 5% of our universe’s current age. This is the first QSO whose spectrum shows clear evidence of an intergalactic medium that is >10% neutral and that reionization is underway. We propose deep HST ACS and WFC/IR imaging of this unique source with two main goals. (i) Unveil the rest-frame UV stellar light from the host galaxy to directly probe supermassive black hole/galaxy co-evolution at the highest accessible redshift. (ii) Search for galaxies physically associated with the QSO and test whether this object resides in one of the densest and most biased environment at the peak of the reionization epoch. HST observations are indispensable to address these topics for two reasons: (a) only HST provides the spatial resolution to separate the central bright light source from the underlying host galaxy and (b) at this record-redshift, only space-based imaging can provide the depths necessary to constrain the environment. These HST observations will provide key insights into the formation and evolution of the first super massive black holes, galaxies, and large-scale structure of the universe.
Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15161
Program Title: The fate of infalling gas during its final approach onto the Milky Way disk

Principal Investigator: Kat Barger
PI Institution: Texas Christian University

The Smith high-velocity cloud is an advanced stage of falling onto the Milky Way's disk. Its compressed head, cometary morphology structure, and diffuse tail—as well as the adjacent cloud fragments along its length—all indicate that this cloud is interacting strongly with its environment. The Smith Cloud has been studied extensively, making it an ideal candidate to assess the mechanisms that disrupt gas as it is deposited onto an Lstar galaxy and to assess how efficiently this S/H = 0.5 solar metallicity cloud disperses metals into the surrounding coronal gas. We will explore the properties of a cloud that recently splintered off the main body of the Smith Cloud using new HST/COS/G130M observations toward 2 QSOs. We will compare this freshly stripped cloud fragment with the gas in the wake of the Smith Cloud, which is in an advanced state of mixing, using published HST/COS/G130M observations toward 3 QSOs. We will combine these observations with already acquired spectroscopically resolved HI 21-cm (0.03 kpc resolution) and H-alpha (0.2 kpc resolution) emission maps to investigate how efficiently the surrounding coronal gas and ionizing radiation field are disturbing this cloud. Using spatial maps of the ionization conditions, chemical composition, and gas motions of a high-velocity cloud, we will further develop a model which uses hydrodynamical simulations with metal mixing and gas condensation to describe the evaporation timescale of galactic fountains as they flow onto Lstar galaxies.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)  

Proposal Category: GO  
Scientific Category: Massive Black Holes And Their Host Galaxies  
ID: 15123  
Program Title: Probing the accretion flow and emission-line regions of M81, the nearest broad-lined low-luminosity AGN  

Principal Investigator: Aaron Barth  
PI Institution: University of California - Irvine  

The nucleus of M81 is an object of singular importance as a template for low-luminosity accretion flows onto supermassive black holes. We propose to obtain a complete, small-aperture, high S/N STIS UV/optical spectrum of the M81 nucleus and multi-filter WFC3 imaging covering the UV through near-IR. Such data have never previously been obtained with HST; the only prior archival UV/optical spectra of M81 have low S/N, incomplete wavelength coverage, and are strongly contaminated by starlight. Combined with new Chandra X-ray data, our proposed observations will comprise the definitive reference dataset on the spectral energy distribution of this benchmark low-luminosity AGN. These data will provide unique new constraints on the possible contribution of a truncated thin accretion disk to the AGN emission spectrum, clarifying a fundamental property of low-luminosity accretion flows. The data will additionally provide new insights into broad-line region structure and black hole mass scaling relationships at the lowest AGN luminosities, and spatially resolved diagnostics of narrow-line region excitation conditions at unprecedented spatial resolution to assess the impact of the AGN on the ionization state of the gas in the host galaxy bulge.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Massive Black Holes And Their Host Galaxies  
ID: 15124  
Program Title: Measuring the Accretion Disk Size in Mrk 509 using Continuum Reverberation Mapping

Principal Investigator: Aaron Barth  
PI Institution: University of California - Irvine

Continuum reverberation mapping from X-rays through optical wavelengths provides a unique probe of accretion disk structure in active galactic nuclei (AGN) on spatial scales of light-days. Recent Swift monitoring campaigns for NGC 5548 and NGC 4151 have provided dramatic evidence that accretion disk sizes are too large to be compatible with standard thin-disk models, requiring a major revision of our understanding of AGN accretion disks. We are currently carrying out an intensive 9-month Swift and ground-based monitoring campaign targeting Mrk 509, an AGN with luminosity an order of magnitude greater than other recent Swift monitoring targets, to map its accretion disk size. The UV and optical filter bands used for photometric monitoring include significant contamination by reprocessed emission from the broad-line region (BLR), including broad emission lines, Balmer continuum, and Fe II emission. In order to quantify the effect of this BLR emission on the accretion disk time delays, we propose to obtain a STIS UV/optical spectrum of the nucleus of Mrk 509 while our Swift campaign is in progress. We will use the STIS spectrum to determine the contribution of broad-line, Balmer continuum, and Fe II emission to each of the UV and optical filters. By correcting for this BLR contamination we will derive wavelength-dependent time delays for the AGN continuum that will provide an accurate measure of the accretion disk size and structure. Our new STIS data will additionally provide new diagnostics of broad-line region and narrow-line region physical conditions and a direct comparison of black hole mass estimates from broad emission lines including H-beta, C IV, and Mg II.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Stellar Populations
ID: 15061
Program Title: Pinpointing the Onset of Multiple Populations in Globular Clusters

Principal Investigator: Nate Bastian
PI Institution: Liverpool John Moores University

We have potentially pinpointed the onset of the multiple populations (MPs) phenomenon during our HST Cycle 23 program where we were looking for an abundance spreads in 12 massive LMC/SMC clusters with wide range of ages. All of the clusters have similar mass (~10^5 Msun), however, not all of the clusters were found to host MPs. From the observed sample, all clusters (five) above an age of 6 Gyr show clear signs of MPs in their post-main sequences (i.e., the RGB), while all clusters (seven) below this age do not show evidence of MPs. Such a relation with age is not expected in any scenario for the origin of MPs, and constitutes one of the most important findings in the field in recent years. One potential explanation for the observations is that MPs do exist within the young clusters, but only below a certain stellar mass limit. We propose to obtain deeper imaging of NGC 419, a 1.5 Gyr cluster that does not show MPs in its RGB (~1.6 Msun), in order to search for splitting along main sequence stars (~1 Msun and below) caused by the chemical anomalies. Based on stellar isochrones with MPs abundance variations, we expect to observe any main sequence splitting with an additional 8 orbits of exposure using our unique filter combination. Determining if a stellar mass limit exists for MPs would consistute a major step forward in the search for the origin of the multiple populations phenomenon.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Stellar Populations  
ID: 15062  
Program Title: Extending the Search for Multiple Populations in Massive Intermediate Age Clusters  
Principal Investigator: Nate Bastian  
PI Institution: Liverpool John Moores University

We propose to obtain imaging of 4 massive clusters in the LMC/SMC, spanning an age range of 2-6.5 Gyr, in order to search for chemical abundance spreads (i.e. multiple populations - MPs) within them. This proposal is meant to compliment our Cycle 23 proposal, which had the unexpected result where we found MPs in all clusters older than 6 Gyr (4 clusters) and did not find MPs in any clusters younger than 2 Gyr (8 clusters). Here we will explore this age gap to pinpoint the exact age where MPs begin to occur on the red giant branch (RGB), which will in turn show the stellar mass where MPs can develop. Additionally, we will study one 6.5 Gyr cluster that is a factor of ~3 less massive than previously studied to look for the influence of cluster mass on whether MPs can develop. The proposed sample occupies a critical region of parameter space (age/mass) where there are no Milky Way counterparts.
Proposal Category: GO
Scientific Category: Solar System
ID: 15094
Program Title: Stellar Occultation by Saturn's Rings in the UV

Principal Investigator: Tracy Becker
PI Institution: Southwest Research Institute

We propose to capitalize on the unique opportunity to observe the July 2018 stellar occultation of the star HD 168233 by Saturn's rings using the COS G230L mode on HST. Our program will characterize the particle size distribution of the rings through analyses of the starlight diffracted by the ring particles. It will also define the shape and structure of the rings through measurements of the optical depth of the variable F ring, the characterization of the self-gravity wakes, and by constraining the A ring edge dynamics six months after the radial swap of the co-orbital moons Janus and Epimetheus, which maintain the ring's outer edge. Saturn's rings are very dark at UV wavelengths; therefore, stellar occultations in the UV have a significantly lower background signal from the ring-reflected sunlight than at longer wavelengths. Furthermore, occultations at UV wavelengths are sensitive to the smallest particles in the rings. The geometry and wavelengths of the stellar occultation from HST COS will complement and extend the science return from the Cassini spacecraft nearly one year after the mission's end.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Solar System
ID: 15095
Program Title: Constraining the Surface Composition of Europa with Spatially Resolved Mid-UV Spectra

Principal Investigator: Tracy Becker
PI Institution: Southwest Research Institute

We propose to observe Jupiter’s icy moon, Europa, to obtain spatially resolved UV spectra of its leading, trailing, sub-Jovian and anti-Jovian hemispheres that include diagnostic mid-UV wavelengths that have not previously been analyzed. Current published observations of Europa include near-UV observations from 210 nm - 320 nm, and far-UV observations from ~110 nm - 170 nm; however, the data in the mid-UV (170 nm - 210 nm) is lacking. Although Europa’s surface consists mostly of water ice, the characteristic sharp absorption edge observed at ~165 nm in lab spectra and on the icy moons of Saturn has not been detected on Europa. Observations in the mid-UV could reveal the absorption edge at longer wavelengths, suggestive of larger ice grains on the surface. Conversely, the mid-UV spectrum could verify that the water ice absorption edge is not present on Europa. The reflectance of Europa’s hemispheres drops significantly between the near- and far-UV. The spectral shape in the mid-UV will be used to constrain the surface composition across the satellite. Mid-UV observations with STIS will span the previous near- and far-UV data sets, providing a seamless UV spectrum. These observations will provide the first spatially resolved spectra of each of Europa’s hemispheres in the mid-UV.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Stellar Populations
ID: 15096
Program Title: The end of the White Dwarf Cooling Sequence of NGC 6752

Principal Investigator: Luigi Bedin
PI Institution: Osservatorio Astronomico di Padova

We propose to study the last HST-accessible white dwarf (WD) cooling sequence (CS) for a nearby globular cluster (GC), the chemically complex, extreme blue horizontal branch cluster NGC 6752.

Over 97% of stars end their lives as WDs, and the WD CS provides constraints not only on the age, but also potentially the star formation history of a GC. The CS of WDs also lies in the least-explored region of the color-magnitude diagram of old stellar populations. Recent deep imaging with HST has successfully reached the end of the WD CS in only three "classical" old GCs, M4, NGC 6397 and 47 Tuc, and reveals an unexpectedly complex, and double-peaked, WD CS in the metal rich old open cluster NGC 6791. One more investigation is in progress on the massive globular Omega Centauri, where over 14 sub-populations are known to exist.

While almost every cluster is known to host multiple populations, every single cluster is unique. NGC 6752 is a bridge between the relatively simple globular clusters, and Omega Cen, the most complex globular cluster known. NGC 6752 has an extended blue horizontal branch, a collapsed core and 3 chemically distinct populations. It is our last chance to add diversity to our very limited sample of WD CS, so far containing only 3 globular clusters, one old open cluster, and the complex Omega Cen system. We need to undertake this investigation while HST is still operational, as there is no foreseeable opportunity in the post-HST era to have one extra WD CS in the homogeneous optical photometric system of HST.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Galaxies and the IGM  
ID: 15125  
Program Title: Galactic fireworks: detecting young stars formed in galactic outflows

Principal Investigator: Francesco Belfiore  
PI Institution: University of California - Santa Cruz

Recent observations have revealed massive galactic outflows of molecular gas, which may have the physical conditions required to form stars. Since outflows are complex, turbulent, multi-phase media, it has so far been challenging to conclusively identify star formation taking place in the flow via classical diagnostics. By exploiting high resolution, high sensitivity, broad band spectroscopy we have recently found evidence for star formation taking place in the fast galactic outflow of a nearby LIRG. We propose to obtain COS observations with two apertures sampling the outflow of this galaxy with the following goals: (1) obtain a direct detection of the hot, young stars formed in the outflow, which are expected to have the same velocity as the outflowing gas; (2) detect and measure the velocity of the young stars formed in the outer part of the outflow, where, according to models, they should form with velocities higher than the escape velocity; (3) determine the properties of the stars formed in the outflow, in particular their average temperature and metallicity; (4) measure the column density and metallicity of the outflowing gas, and thus constrain the amount of gas in the outflow and, therefore, the efficiency of star formation in this environment.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: SNAP
Scientific Category: Massive Black Holes And Their Host Galaxies
ID: 15215
Program Title: A Local Baseline of the Black Hole Mass - Host Galaxy Scaling Relations for Active Galaxies

Principal Investigator: Vardha Bennert
PI Institution: Cal Poly Corporation, Sponsored Programs Department

The discovery of relations between supermassive black holes (BHs) and their host-galaxy properties has sparked many observational studies pertaining both to the local Universe and cosmic history. Nevertheless, a clear understanding of their origin and fundamental drivers still eludes us. Studying the evolution of these relations depends on our understanding of the slope and scatter of local relations for active galaxies (AGNs). We propose a SNAP program of a unique sample of 84 local type-1 AGNs, spanning a wide range of BH masses (MBH), morphologies, and stellar masses. The high resolution WFC3/F814W images are essential for a detailed decomposition of the host-galaxy in the presence of a bright AGN point source, resulting in precise measurements of the different host-galaxy components and AGN luminosity free of host-galaxy contamination for a robust determination of MBH. When complemented with spatially-resolved Keck spectra to determine stellar-velocity dispersion within bulge effective radius, this yields a most complete baseline of host-galaxy properties over the entire range of MBH scaling relations. A typical SNAP completion rate results in a sample of ~30 objects which will be used to calibrate existing Gemini NIRI and SDSS images. We will study slope and scatter of the relations, dependencies and fundamental drivers. The frequency of pseudo-bulges, bars, and (minor) mergers will reveal the dominant growth mechanism of spheroids. The homogeneous sample will identify any selection biases in the reverberation-mapped AGN sample which serves as a MBH calibrator for the entire Universe. Results will be compared with state-of-the-art semi-analytical models.
Proposal Category: GO
Scientific Category: Massive Black Holes And Their Host Galaxies
ID: 15263
Program Title: The Host Galaxy of the Low Mass Black Hole in UGC 06728

Principal Investigator: Misty Bentz
PI Institution: Georgia State University Research Foundation

We propose to obtain high-resolution, multicolor imaging of the host-galaxy of UGC 06728, a nearby (z=0.0065) low-luminosity Seyfert. A recent reverberation-mapping campaign has constrained the black hole mass to $7 \times 10^5$ M$_\odot$, but little is currently known about the host galaxy due to the lack of spatial resolution in existing, seeing-limited images. Based on the black hole mass and the bulge stellar velocity dispersion, it is likely that a black hole mass could also be derived from modeling the nuclear stellar dynamics of UGC 06728. The number of galaxies where comparison of stellar dynamics and reverberation mapping is possible is very small (<10) due to their non-overlapping technical requirements, so UGC 06728 is an important target for testing the consistencies of black hole masses from different techniques. The proposed images will allow us to characterize the host-galaxy features and morphology for the first time. They will also allow us to determine the central stellar surface brightness for follow-up AO-assisted near-IR integral field spectroscopy, accurately constrain the stellar mass-to-light ratio of the galaxy, and correct the AGN luminosity for starlight contamination (to include UGC 06728 at the low end of the AGN R-L relationship). We will also investigate the globular cluster population around the galaxy and the potential to determine its distance using the globular cluster luminosity function method. The proposed observations will facilitate the direct comparison of masses from reverberation mapping and stellar dynamics, which is critical to ensure that all black holes, from Local Group galaxies to z~7 quasars, are on the same mass scale.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Galaxies and the IGM  
ID: 15126  
Program Title: Resolving the Abundance Discrepancy with HST/COS

Principal Investigator: Danielle Berg  
PI Institution: University of Wisconsin - Milwaukee

A long-standing problem in nebular astrophysics is the discrepancy between abundances derived from collisionally-excited optical emission lines (CELs) and optical recombination emission lines (RLs). Because the optical RLs are intrinsically very faint, there is only a small collection of extragalactic HII regions for which abundances from RLs are available. C/O relative abundances are measured for a subset of these. By observing CIII] 1907,1909 and OIII] 1661,1666 in the ultraviolet, we can obtain a very secure measurement of the C/O ratio from CELs. Comparing the C/O relative abundances from UV CELs with those from optical RLs provides an independent test of the abundance discrepancy.

Using the LBT, we have obtained high quality optical spectra for a large sample of HII regions in M101. We have detected the C III 4267 line in 10 of these regions. By observing these 10 regions, which span nearly a dex in oxygen abundance, we can compare the C/O and C/H abundances in these regions to provide an independent test of the abundance discrepancy. This study will also result in the most accurately measured carbon abundance gradient in a spiral galaxy.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15329
Program Title: Fine-Tuned Search for Kilonova Emission in a Short Gamma-Ray Burst:
   Implications for the Progenitors, Advanced LIGO, and r-Process Nucleosynthesis
Principal Investigator: Edo Berger
PI Institution: Harvard University

Short-duration gamma-ray bursts have long been suspected to result from the catastrophic mergers of binaries composed of two neutron stars (NS-NS) and/or a neutron star and a black hole (NS-BH). This possible association is of fundamental importance since these binaries are also strong gravitational wave emitters, and the short GRB connection can therefore guide electromagnetic follow-up of Advanced LIGO gravitational wave sources. An important direct signature of NS-NS/NS-BH progenitors is near-infrared emission powered by radioactive r-process material synthesized by the ejection of neutron-rich matter during the merger, a so-called "kilonova". HST observations of the short GRB130603B provided the first tantalizing evidence for such an emission component, but unfortunately lacked detailed spectral and temporal information. Here, we propose fine-tuned TOO observations of a future short GRB that will definitively establish the presence of a kilonova and will also allow us to distinguish an NS-NS from an NS-BH merger, based on the ejecta mass (~0.01 vs. ~0.1 Msun, respectively). The results will not only serve as a smoking gun for compact object merger progenitors, but they will also guide our plans for optical/infrared follow-up of Advanced LIGO sources, and establish whether compact object mergers are the primary site for cosmic r-process nucleosynthesis. To support and interpret the proposed HST observations, and to rule out alternative explanations for any detected emission, we will obtain a wide range of observations spanning radio to X-rays using active programs at Gemini, Magellan, MMT, VLA, Chandra, and XMM.
Spiral galaxies dominate the stellar mass density in the Universe, yet the details of their formation and evolution are still greatly debated. The simulations based on the current cosmological model show that these galaxies grow in mass through accretion and mergers. One of the consequence of this galaxy assembly process is the formation of an old, metal-poor stellar halo. However, to date the presence of a spheroidal component in low-mass spirals is elusive and controversial, mostly due to the difficulty to detect such a faint, diffuse component amid the foreground/background contamination. We propose a novel method to detect and characterize such a halo in the nearby, edge-on spiral galaxy NGC 55, that by-passes these limitations by using the pulsational properties of its RR Lyrae stars. These observations will allow us to i) firmly establish the presence of an old stellar halo, ii) quantify its early chemical evolution, and iii) determine the nature of its building blocks. We will use the resulting deep color-magnitude diagrams reaching 1.5 magnitudes below the horizontal-branch to test halo and thick disk formation models.
Proposal Category:    GO
Scientific Category: Planets and Planet Formation
ID:                  15264
Program Title:       The M Dwarf UV Spectra Irradiating Nearby Transiting Terrestrial Planets

Principal Investigator: Zach Berta-Thompson
PI Institution:       University of Colorado at Boulder

Of the 500 stars within 12 pc, we know of three very low-mass M dwarfs that host small transiting planets: LHS1140, TRAPPIST-1, and GJ1132. All of these planets appear to be rocky, and some orbit in their stars's habitable zones. Thanks to their stars' proximity and small sizes, the atmospheres of these planets are within reach of spectroscopic characterization by JWST and giant ground-based telescopes. Here, we propose to use Hubble to gather deep ultraviolet spectra of these important M dwarfs. These UV spectra are crucial for understanding the habitability of planets around these stars. Without knowledge of the high-energy radiation environment in which these planets reside, it is impossible to understand their evolution or to interpret observations of their atmospheres. UV light can promote obscuring hazes in a planetary atmosphere, or even produce biosignature false positives. The Hubble Space Telescope is the only facility that can observe the UV spectra of these systems. With no future UV capabilities planned to overlap with JWST, it is essential that we characterize these planet hosts with HST as soon as possible.
Understanding the assembly history and dark matter distribution of our Milky Way (MW) is a major challenge for astrophysics. Thanks to the unique capabilities of HST, proper motions of satellite galaxies, globular clusters and stellar streams have been measured with accuracies of order ~0.05 mas/yr (~10 km/s) at distances of 50-300 kpc. When combined with detailed models of the MW’s halo potential, such measurements become high-precision tools to constrain the dark matter mass profile of the MW and compute accurate orbital histories of satellites. However, the MW hosts a pair of massive dwarf galaxies, the LMC and SMC, that contribute to its dark matter distribution and change the shape of the potential in a non-symmetrical, time evolving manner. To date, these effects have not been accounted for in existing models of the MW halo. We propose to develop high resolution simulations to quantify the time evolving structure of the MW’s dark matter halo owing to the influence of the LMC and SMC. These novel models will enable rapid orbital integration of halo objects (satellites, globular clusters, stellar streams), using high accuracy HST proper motions, while also capturing the complex halo potential resulting from the LMC-SMC-MW interaction. The era of high-precision astrometry has arrived, yet we do not currently have an appropriate theoretical framework to study the assembly history of MW-like galaxies in the presence of massive satellite perturbers. Our proposed program is thus critical to ongoing HST programs and all efforts to understand the structure and evolution of the dark matter halo of our Galaxy and analogous systems like M31 and its massive satellite, M33.
ACS SBC imaging of the extended hydrogen exosphere of Mars is proposed to identify the hot hydrogen population present in the exosphere of Mars. Determining the characteristics of this population and the underlying processes responsible for its production are critical towards constraining the escape flux of H from Mars, which in turn is directly related to the water escape history of Mars. Since the hot atoms appear mainly at high altitudes, these observations will be scheduled when Mars is far from Earth allowing us to image the hot hydrogen atoms at high altitudes where they dominate the population. The altitude coverage by HST will extend beyond 30,000 km or 8.8 Martian radii in this case, which makes it perfect for this study as orbiting spacecraft remain at low altitudes (MAVEN apoapse is ~ 6000 km) and cannot separate hot atoms from the thermal population at those altitudes. The observations will also be carried out when Mars is near aphelion, the atmospheric temperature is low, and the thermal population has a small scale height, allowing the clear characterization of the hot hydrogen layer. Another advantage of conducting this study in this cycle is that the solar activity is near its minimum, allowing us to discriminate between changes in the hot hydrogen population from processes taking place within the atmosphere of Mars and changes due to external drivers like the solar wind, producing this non-thermal population. This proposal is part of the HST UV initiative.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Solar System
ID: 15098
Program Title: Calibrating ACS-SBC Using STIS at Lyman Alpha (121.567 nm)

Principal Investigator: Dolon Bhattacharyya
PI Institution: Boston University

This short calibration program is needed to correctly interpret existing STIS and ACS data on the exospheres of several solar system objects. It will allow us to calibrate observations of planetary exospheres, and to quantitatively determine the atmospheric escape flux, from Mars, Uranus, Titan and other solar system objects, and to contribute to the calibration of the MAVEN IUVS instrument. The need for added calibration is driven by the large uncertainty in the sensitivity of ACS/SBC images at H Lyman alpha (121.6 nm) and also by the lack of a Lyman alpha flat field for STIS G140L long aperture spectra, in both cases for diffuse emissions. The STIS instrument sensitivity is well calibrated at Lyman alpha in the G140L mode through calibration star observations, but there is no flat field specifically at Lyman alpha for diffuse emissions filling the aperture. The ACS/SBC F115 mode is calibrated for a mean wavelength in the bandpass, but as an imaging instrument the specific sensitivity at Lyman alpha has not been measured. These calibrations could be obtained through observations of the geocoronal Lyman alpha emission, comparing the count rates of STIS G140L and ACS/SBC for the same diffuse source brightness, and obtaining the STIS Lyman alpha flat field from the observations of diffuse emission. This study will be beneficial for both the planetary and the astrophysics community as hydrogen is the most abundant element in our universe and Lyman alpha is the most probable transition in H atoms. The flat field for STIS in Lyman alpha will benefit the analysis of past and future GO program data and will be delivered to STScI for use by the observational community.
The AGN unification scheme suggests that Type 2 AGN are identical to type 1 AGN, just observed from the side, where an inner torus structure obscures a direct view of the continuum and broad line region (BLR) emission. Is this unification scheme always true? In some low luminosity type 2 AGN we have a direct view of the innermost regions, as indicated by an unabsorbed and rapidly variable X-ray emission, yet no broad lines are observed. Are these true Type 2 AGN (i.e. the BLR is truly missing), or is the BLR emission just hard to detect in these weak AGN? Here we propose to address this question with the best true Type 2 AGN candidate, namely NGC 3147. If the narrow slit HST spectrum of the nucleus does not reveal the expected very broad and weak H alpha emission, then NGC 3147 can be declared as a Golden true type 2 AGN. It will show beyond any doubt that such objects do exist. If the BLR is detected, with the predicted extremely large line width, it will provide a stringent test of the mass scaling relations widely used and accepted by the community, opening up the possibility to measure directly the BH mass in nearby weakly active galaxies.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Stellar Physics  
ID: 15216  
Program Title: Characterizing the Supernova Remnant Population of the Fireworks Galaxy, NGC 6946  

Principal Investigator: William Blair  
PI Institution: The Johns Hopkins University

Characterizing large uniform samples of supernova remnants (SNRs) in spiral galaxies can lead to fundamental insights about the stellar cycle of life, death, and rebirth. We have underway a comprehensive multiwavelength (optical, near-IR, radio, X-ray) campaign using both imaging and spectroscopy to identify and characterize the rich SNR population in NGC 6946, which has produced more historical SNe than any other galaxy. Our catalog of ~200 candidates from ground-based imaging is missing key information about their size and morphology, since at the 5.9 Mpc distance, where 1" = 33 pc, all the smaller (younger) SNRs are unresolved. We request HST (WFC3 UVIS) imaging in H-alpha and [S II] 6716, 6731 of seven fields in NGC 6946, which will allow us to (a) measure sizes and morphologies of the ground-based SNR candidates, (b) identify small-diameter SNR candidates missed in the ground-based survey or located in confused regions, (c) search for optical traces from any of the 7 (out of 9) historical SNe within our survey region, and (d) search for any exceptional objects such as very young SNRs or micro-quasars that may be masquerading as normal SNR candidates. We also propose to use deep photometry and CMD-fitting on archival HST-ACS two-color broadband imagery of three fields, plus one additional ACS field proposed here, to determine the age of the stellar population surrounding many of the SNRs, and thus constrain the masses of their progenitor SNe. Finally, we will compare NGC 6946 with a similarly comprehensive analysis we have done for M83 to understand what characteristics might be galaxy dependent versus more universal.
The MASSIVE survey is targeting the ~100 most massive galaxies within 108 Mpc that are visible in the northern sky. These most massive galaxies in the present-day universe reside in a surprisingly wide variety of environments, from rich clusters to fossil groups to near isolation. We propose to use WFC3/UVIS and ACS to carry out a deep imaging study of the globular cluster populations around a selected subset of the MASSIVE targets. Though much is known about GC systems of bright galaxies in rich clusters, we know surprisingly little about the effects of environment on these systems. The MASSIVE sample provides a golden opportunity to learn about the systematics of GC systems and what they can tell us about environmental drivers on the evolution of the highest mass galaxies. The most pressing questions to be addressed include: (1) Do isolated giants have the same constant mass fraction of GCs to total halo mass as BCGs of similar luminosity? (2) Do their GC systems show the same color (metallicity) distribution, which is an outcome of the mass spectrum of gas-rich halos during hierarchical growth? (3) Do the GCs in isolated high-mass galaxies follow the same radial distribution versus metallicity as in rich environments (a test of the relative importance of growth by accretion)? (4) Do the GCs of galaxies in sparse environments follow the same mass function? Our proposed second-band imaging will enable us to secure answers to these questions and add enormously to the legacy value of existing HST imaging of the highest mass galaxies in the universe.
Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15162
Program Title: Constraining the Late-Time Light Curve Behavior of Three Diverse Superluminous Supernovae

Principal Investigator: Peter Blanchard

PI Institution: Harvard University

The current generation of untargeted optical time-domain surveys have led to the discovery of rare and extreme transients such as superluminous supernovae (SLSNe). The mechanism that powers the hydrogen-poor Type I SLSNe remains elusive, though models such as a magnetar central engine and interaction with a hydrogen-poor circumstellar medium are both major contenders. One of the most promising observational methods available to test these models is to track the light curve evolution to very late times where model predictions diverge. We propose to obtain ACS/WFC imaging of three Type I SLSNe (PS16aqv, PS16fgt, and Gaia16apd) at greater than 500 rest-frame days after peak brightness when only HST provides the required sensitivity. These events span the diversity of decline timescales and colors exhibited by Type I SLSNe and will allow us to compare the late-time evolution of a diverse sample of events among themselves and with model predictions. These HST observation will be the latest ever of Type I SLSNe and will help to address important questions regarding their power source and diversity.
Proposal Category: GO
Scientific Category: Massive Black Holes And Their Host Galaxies
ID: 15226
Program Title: Stellar Luminosity Profiles for Precision Measurements of Black Hole Mass in Early-Type Galaxies

Principal Investigator: Benjamin Boizelle

PI Institution: University of California - Irvine

We have obtained ALMA CO(2-1) data for a sample of nearby early-type galaxies, of which nine are detected in CO at high S/N and show rotation-dominated kinematics. We are in the process of modeling the kinematics of these molecular gas disks to derive accurate measurements of the black hole masses in these galaxies. Near-IR imaging is essential in order to measure the stellar luminosity profiles for these galaxies with dusty circumnuclear disks, and WFC3/IR imaging data is available or pending for only two of our CO disk galaxies. We propose to obtain WFC3/IR and UVIS data for the remaining seven galaxies. Gas mass measurements suggest that the dust extinction may reach ∼1 mag in the H-band, and we are developing a modeling method to recover pixel-by-pixel extinction maps for these dust disks and produce dust-corrected stellar luminosity profiles using imaging in filters from the B to H bands. Using the dust-corrected stellar luminosity profiles together with the ALMA kinematic data, we will be able to determine black hole masses with precisions reaching ∼10%. We request a single orbit for each of the seven galaxies.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: AR
Scientific Category: Stellar Physics
ID: 15005
Program Title: Archival Investigation of Outburst Sites and Progenitors of Extragalactic Intermediate-Luminosity Mid-IR Transients

Principal Investigator: Howard Bond
PI Institution: The Pennsylvania State University

Our team is using Spitzer in a long-term search for extragalactic mid-infrared (MIR) variable stars and transients—the SPIRITS project (SPitzer InfraRed Intensive Transients Survey). In this first exploration of luminous astrophysical transients in the infrared, we have discovered a puzzling new class. We call them SPRITEs: eSpecially Red Intermediate-luminosity Transient Events. They have maximum MIR luminosities between supernovae and classical novae, but are not detected in the optical to deep limits. To date, we have discovered more than 50 SPRITEs in galaxies out to ~17 Mpc.

In this Archival Research proposal, we request support in order to investigate the pre-eruption sites in HST images of some 3 dozen SPRITEs discovered to date, and an additional ~2 dozen that we are likely to find until the end of Spitzer observing in late 2018. Our aims are (1) characterize the pre-outburst environments at HST resolution in the visible and near-IR, to understand the stellar populations, stellar ages and masses, and interstellar medium at the outburst sites; (2) search for progenitors; (3) help prepare the way for a better understanding of the nature of extragalactic IR transients that will be investigated by JWST.
The super-Earth HIP116454b was the first exoplanet detected by the K2 mission, in transit across a bright and nearby K1 dwarf (V=10.2, d=55 pc). The low density of the planet suggests it must have at least 30% water or a 0.5% H-He envelope. Given the strong XUV irradiation from the young (2 Gyr) host star, this H-He envelope should have been lost through evaporation in a few hundred millions year, suggesting that HIP 116454b likely contains a large mass fraction of water. The shallow transit depth makes difficult the search for water vapor in the lower atmosphere with HST/WFC3. The moderate orbital distance of this warm (~700 K) planet favors the formation of a super-critical steam envelope, which should be promptly dissociated at high altitude by the XUV irradiation and become observable as hydrogen flowing within and beyond the Roche lobe. The host star is similar to HD 189733, host to an evaporating hot Jupiter, and numerical simulations of HIP116454b show that the hydrogen exosphere resulting from the dissociation of water is observable with HST/STIS at Ly-alpha. The detection of this exosphere would be the first signature of an evolved evaporating ocean on an extrasolar planet, as well as the first validation of internal structure models of exoplanets in this mass regime. It would also determine how to best search for water in the lower atmosphere of HIP116454b with the JWST. A non-detection of escaping hydrogen, as with 55 Cnc e and HD 97658b, would bring useful constraints on the nature of the planetary atmosphere, the evolutionary path of close-in super-Earths, and the progenitors of the rocky evaporation remnants detected by Kepler.
Ultra Diffuse Galaxies (UDGs) are galaxies with large effective radii but very low surface brightness. They were recently discovered in unprecedented numbers in the Coma Cluster, and are now being found in other clusters, as well as in the field. Their origin remains far from clear. In this proposal, we request time to observe three QSOs that lie behind three UDGs, using the COS G130M grating, in order to search for absorption lines from the interstellar and circumgalactic medium of the UDGs. Because the properties of UDGs are likely tied to their locations, the UDGs have been selected to reside in three different environments — in Coma, in the Fornax Cluster, and in the field. The QSO sightlines probe the inner regions of the galaxies at radii of 1, 7 and 11 kpc, which should be small enough to detect high column densities of neutral hydrogen, N(H I), akin to gas clouds that give rise to Damped Lyman-alpha or Lyman Limit QSO absorption line systems (QSOALs). This is particularly likely towards the gas-rich field UDG SECCO-dl-2 from which 21cm emission has recently been detected. This high N(H I) absorption, along with the corresponding metal absorption lines, will enable us to measure the ionization conditions of the ISM and CGM, its velocity structure, and especially its metallicity, which can be used to help constrain the chemical evolution of the galaxies and shed light on their origin. This will be the first study of absorption lines from this type of galaxies, and will demonstrate whether or not UDGs contribute significantly to the population of QSOALs in the universe.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15196
Program Title: How Do Inflows and Outflows from Galaxies Create Their Inner Circumgalactic Medium?

Principal Investigator: David Bowen
PL Institution: Princeton University

We propose using COS to observe 7 QSO sightlines within half a virial radius each of two galaxies in order to probe their circumgalactic mediums (CGMs) along multiple sightlines. Results from higher redshift QSO absorption line surveys suggest that this is the region where most metal line absorbing gas clouds reside, but their origin remains controversial. The two spiral galaxies studied in this proposal are NGC 4565 (the Needle Galaxy) which is highly inclined (i=86 degrees), and NGC 3184, which has a very low inclination (i=9 degrees). Their orientation makes them ideal targets for looking for kinematic and metallicity signatures from outflows along the minor axis, or inflows into the disk along the major axis. For both galaxies, we will measure how HI and metal line column densities change globally with radius, and how the ionization structure of the absorbers varies with position. We predict that the HI column densities we detect will be similar to the Lyman Limit, or partial-Lyman Limit systems, and that we will be able to measure the gas metallicity in these clouds. These measurements can be used to infer whether the absorbing gas is flowing into the galaxy from the IGM (where the metallicity is lower than in the galaxy) or out of the galaxy (which should be metal enriched). Given that LLS and pLLS have been shown to have a bimodal distribution in their metallicity, we will see which of the two regimes the gas in our galaxies belong to, and even whether the bimodality can be seen in a single galaxy towards different sightlines.
Proposal Category: GO
Scientific Category: Planets and Planet Formation
ID: 15197
Program Title: Rotation Periods and Cloud Dynamics of Directly Imaged Exoplanets

Principal Investigator: Brendan Bowler
PI Institution: University of Texas at Austin

Precision photometric monitoring of brown dwarfs has shown that variability spanning a broad range of amplitudes (0.1-30%) is extremely common in the infrared. These periodic changes are likely caused by rotationally-modulated features produced by heterogeneous coverage of condensate clouds. Time series spectroscopy is an especially informative tool; by simultaneously probing a range of wavelengths, pressure levels, and evolving phases, this method has opened a new window into the atmospheric structure and dynamics of ultracool atmospheres. Recent observations of young brown dwarfs and planetary-mass objects indicate that high-amplitude (~10%) variability may be even more common at low surface gravities. We propose to obtain the first-ever rotational phase maps for three directly imaged exoplanets with time series WFC3/IR spectroscopy to measure the rotation, cloud structure, and atmospheric dynamics of young (2-300 Myr) giant planets. In addition, by combining projected rotational velocities from high-resolution near-infrared spectroscopy of these planets, these spectroscopic light curves will also be used to determine the first obliquity angle of an imaged exoplanet.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: AR
Scientific Category: Galaxies and the IGM
ID: 15006
Program Title: Dwarf Galaxies from Deep Fields to the Near Field

Principal Investigator: Michael Boylan-Kolchin

PI Institution: University of Texas at Austin

We propose to use cosmological hydrodynamical simulations - both zoom-in and large-volume - to study the connections between the faintest observable galaxies in the high-redshift Universe and dwarf galaxies locally.

Studies of the likely descendants of very faint HUDF / Frontier Field galaxies will provide a powerful complement to direct observations at z~8 for investigating the physical processes in the high-redshift Universe and, in connection with properties of low-mass galaxies in the nearby Universe, will produce strong constraints on reionization scenarios and dark matter models. Understanding the relationship between high-redshift and local galaxy populations through simulations requires an accurate knowledge of the links between galaxy populations at cosmic dawn and those locally. All existing results on this topic either suffer from poor statistics or are unable to resolve the hosts of Frontier Field galaxies, however. Our program will address this shortcoming by combining a series of zoom-in hydrodynamical simulations with the next generation of large-volume hydrodynamical simulations of the galaxy population from the Illustris project.

HST has made unique and invaluable contributions to surveys of galaxies at high redshifts and to detailed, resolved-star studies of individual galaxies in the very nearby Universe. Our study will help cement links between these two HST legacies. We will quantify the relationships between faint populations at low and high redshifts, characterize the merger histories of dwarf galaxies (both forward and backward in time), and test the validity of various popular models such as abundance matching based on UV luminosity functions.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: AR  
Scientific Category: Cosmology  
ID: 15007  
Program Title: Testing methods to measure dark matter substructure with gravitational lensing  
Principal Investigator: Sean Brennan  
PI Institution: Rutgers the State University of New Jersey

Some strong gravitational lens systems exhibit features that cannot be explained by a smooth mass distribution. A possible explanation for these anomalies is the presence of dark matter substructure of the type predicted by LCDM. Much work has been done to use these anomalous lens systems to attempt to detect individual dark matter clumps. The standard approach is to increase the complexity of the model to include a component that can account for a single dark matter clump. Some groups go on to use the clumps in their models to constrain the subhalo mass function and abundance, and in doing so assume that the modeled clump corresponds to a physical clump in the lens. Our goal is to quantify the reliability of this assumption. We will create realistic mock lenses with substructure, use them to create mock lensed images, and fit those images with single clump models. Working with mock lenses means we can quantify how systematic effects may bias the conclusions we draw about the clump’s properties. Any bias in this step will propagate into the constraints placed on the mass function or abundance of dark matter. We will carry out this analysis for quasar lenses and galaxy lenses.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: AR
Scientific Category: Massive Black Holes And Their Host Galaxies
ID: 15008
Program Title: Spatially Resolved Emission Line Ratios for Nuclear AGN Selection

Principal Investigator: Joanna Bridge
PL Institution: The Pennsylvania State University

Differentiating between AGN activity and star formation in z ~ 2 galaxies is difficult because traditional methods such as line ratio diagnostics change with redshift, while multiwavelength methods (X-ray, radio, IR) are sensitive to only the brightest AGN. We have developed a new method for spatially resolving emission lines in HST/WFC3 G141 grism spectra, quantifying AGN activity through the spatial gradient of the [O III]/Hbeta line ratio. Through detailed simulations, we have shown that our novel line-ratio gradient approach identifies low-mass and obscured AGN well beyond the limits of classic methods. In the course of this archival program, we will extend the current simulations beyond stellar mass, star formation rate, and AGN accretion, additionally modeling the effects of different galaxy sizes and morphologies. We will then use the two-orbit 3D-HST G141 grism observations and 12- and 40-orbit G102 grism observations from FIGS and CLEAR in the CANDELS fields of several thousand 0.6 < z < 2.3 galaxies to take a complete AGN census at cosmic noon. The HST grism is the ideal tool for this work because its unique spatial abilities applied to such a large dataset are unparalleled. Our simulations of spatially resolved AGN+galaxy emission lines will inform many related studies of resolved galaxy properties, such dust, star formation rate, metallicity.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Stellar Physics  
ID: 15128  
Program Title: Inner Disk Structure and Transport Mechanisms in the Transitional Disk around T Cha  
Principal Investigator: Alexander Brown  
PI Institution: University of Colorado at Boulder

To better understand how Earth-like planets form around low-mass stars, we propose to study the UV (HST), X-ray (XMM), and optical (LCOGT) variability of the young star T Cha. This variability is caused by obscuration of the star by clumpy material in the rim of its inner disk. Changing sight lines through the disk allow measurement of the temperature and column density of both molecular and atomic gas and the physical properties of the dust grains in the well-mixed inner disk, as well as determining the gas-to-dust ratio. The gas-to-dust ratio affects planetesimal growth and disk stability but is difficult to measure in local regions of disks. Three 5 orbit visits, separated by 3-7 days, are required for use of analysis techniques comprising both differential "pair-method" comparison of spectra with differing A_v (particularly important for determining the dust extinction curve, A_lambda, where removal of the foreground extinction requires multiple epochs) and detailed spectral fitting of gas absorption features at each epoch. The inner disk of T Cha is particularly interesting, because T Cha has a transitional disk with a large gap at 0.2-15 AU in the dust disk and allows study of the gas and dust structure in the terrestrial planet formation zone during this important rapid phase of protoplanetary disk evolution. Characterizing the high energy (UV/X-ray) radiation field is also essential for in-depth studies of the disk in other spectral regions. Results from these observations will have wide relevance to the modeling and understanding of protoplanetary disk structure and evolution, and the complex gas and dust physics and chemistry in disk surface layers.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: AR
Scientific Category: Galaxies and the IGM
ID: 15009
Program Title: Surveying the CGM and IGM across 4 orders of magnitude in environmental density

Principal Investigator: Joseph Burchett
PI Institution: University of Massachusetts - Amherst

Environment matters when it comes to galaxy evolution, and the mechanisms driving this evolution are reflected in the diffuse gas residing within the large-scale structures enveloping the cosmic galaxy population. QSO absorption lines effectively probe the circumgalactic medium (CGM) and intragroup and intracluster media, and work thus far hints at profound environmental effects on the CGM. However, sample sizes remain small, and a unifying picture of the gas characteristics across diverse environments has yet to emerge. Within the Sloan Digital Sky Survey, we have identified a sample volume containing a remarkable diversity in large-scale environment with an array of voids, >10,000 groups, several filaments, and 5 clusters, including the Coma Supercluster and CfA Great Wall. Leveraging the Hubble Spectroscopic Legacy Archive (HSLA), we propose a study using >360 background QSOs probing this volume to study the effects of large-scale environment on CGM and intergalactic medium (IGM) gas. The z = 0.019-0.028 spectroscopic galaxy sample is uniformly complete to galaxies L > 0.03 L* and, with the HSLA, produces ~200 galaxy/sightline pairs within 300-kpc impact parameters across a wide range of environmental densities and structures.

Upon quantifying the galaxy environment and identifying/measuring the QSO absorption lines at z = 0.019-0.028, we will pursue the following primary science goals:
1. Constrain the CGM/IGM physical conditions across four orders of magnitude in galaxy density
2. Compare ionic abundances and ionization states in the CGM of galaxies in filaments vs. voids
3. Statistically investigate the IGM/CGM gas properties from structure to structure
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15227
Program Title: Finding the missing metals around the Universe's most prodigious polluters

Principal Investigator: Joseph Burchett
PI Institution: University of Massachusetts - Amherst

Analysis of the Hubble Deep Fields reveals that star-formation in the early universe is dominated by the faintest galaxies detected, and the formation and evolution of these dwarf galaxies drives the reionization, enrichment, and subsequent formation of more massive systems. In tandem, two decades of cosmological simulations have at least reached one consensus: reproducing realistic galaxy populations critically depends on the treatment of galactic feedback. Stellar and galactic winds regulate star formation but also distribute metal-enriched gas throughout the interstellar medium (ISM), into the circumgalactic medium (CGM), and beyond. Thus, a firm theoretical foundation to our understanding of galaxy evolution hinges on reproducing the enrichment and transport of heavy elements through the stars, ISM, CGM, and intergalactic medium. Current technology affords a detailed census of the metals currently in stars as well as those produced over the star formation history only in local analogs to the early dwarf polluters. Meanwhile, QSO absorption line spectroscopy can constrain the CGM component. We propose observations of UV-bright QSOs that probe the CGM of a sample of very-nearby low-mass dwarf galaxies for which the HST archive contains imaging suitable to constrain the metal production history, and the QSO spectra will enable us to 1) search for metal-enriched CGM material both at the velocities of the dwarfs and at high velocities characteristic of outflows, 2) estimate the mass of total carbon residing in these dwarf galaxy halos, and 3) compare these derived masses or limits with the amount of missing metal mass from the inner galactic regions.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Planets and Planet Formation
ID: 15129
Program Title: Completing Kepler's Mission to Determine the Frequency of Earth-like Planets

Principal Investigator: Christopher Burke
PI Institution: SETI Institute

The primary goal of NASA's Kepler mission is to estimate the frequency of Earth-sized planets orbiting in the habitable zone (HZ) of Sun-like stars (so called eta-Earth). Analysis of four years of Kepler data reveals an unprecedented population of more than 4400 planet candidates orbiting 3400 stars, however only a small subset of these (~13 planets) fall into the regime of near-Earth-sized and in the HZ of a solar-type star. By accounting properly for detection biases that limit the catalog completeness and reliability we can turn an observed population into an intrinsic population and achieve Kepler's prime mission goal. Our team have shown that uncertainties in HZ occurrence rates for solar-type stars for all analyses to date are dominated by systematic uncertainties. The robustness of the 13 high-value Earth-like planet candidates is questionable due to their long periods and small transit depths - the Kepler team estimate that perhaps 50% of these are real planets. The proposed HST observations provide a pilot study to measure the photometric time series of the high-value, temperate terrestrial planet candidate Kepler-62f in order to confirm that it is not a false alarm. Long-duration high-precision observations from HST of this kind have not been attempted before and therefore we opt to waive the proprietary period of data collected during this pilot study. Successful confirmation will pave the way for a future large program to examine all of the Kepler G dwarf habitable Earth-sized planets and drastically improve the accuracy of eta-Earth estimates.
Stellar Population Synthesis (SPS) models are routinely used to interpret extragalactic observations at all redshifts. Currently, the dominant source of uncertainty in SPS modeling lies in the degeneracies associated with synthesizing and fitting complex stellar populations to observed galaxy spectra. To remedy this, we propose an empirical calibration of SPS models using resolved stellar population observations from Hubble Space Telescope (HST) to constrain the stellar masses, ages, and star formation histories (SFHs) in regions matched to 2D spectroscopic observations from MaNGA. We will take advantage of the state of the art observations from the Panchromatic Hubble Andromeda Treasury (PHAT), which maps the dust content, history of chemical enrichment, and history of star formation across the disk of M31 in exquisite detail. Recently, we have coupled these observations with an unprecedented, spatially-resolved suite of IFU observations from MaNGA. With these two comprehensive data sets we can use the true underlying stellar properties from PHAT to properly interpret the aperture-matched integrated spectra from MaNGA. Our MaNGA observations target 20 regions within the PHAT footprint that fully sample the available range in metallicity, SFR, dust content, and stellar density. This transformative dataset will establish a comprehensive link between resolved stellar populations and the inferred properties of unresolved stellar populations across astrophysically important environments. The net data product will be a library of galaxy spectra matched to the true underlying stellar properties, a comparison set that has lasting legacy value for the extragalactic community.
Proposal Category: GO
Scientific Category: Planets and Planet Formation
ID: 15217
Program Title: Imaging the predicted asteroid belt analogue around Epsilon Eridani

Principal Investigator: Kerri Cahoy
PI Institution: Massachusetts Institute of Technology

We propose to take advantage of the STIS coronagraphic mode and advances in speckle subtraction techniques to probe for scattered light from Epsilon Eridani’s predicted asteroid belt analog to contrasts an order-of-magnitude deeper than past ground based studies. This proposal tests for the presence of visible scattered light from a warm dust ring at 1 arcsecond with a 5e-5/\text{as}^2 contrast, predicted from observations of the 24 micron excess. Dust morphology and scattered light brightness (exozodi) present a significant challenge to future exoplanet imaging missions, and Epsilon Eridani is an excellent sunlike candidate for future exoplanet direct imaging missions due its easily accessible habitable zone.

Either a detection of scattered light from this circumstellar dust population or a non-detection will place valuable constraints on the dust composition, morphology, and transport mechanisms at work in the system and inform future direct imaging efforts of this nearby star system.
Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15266
Program Title: Imaging the Most Massive Galaxy Overdensities at z=2.2: The Morphology-Density Relation at High Redshift

Principal Investigator: Zheng Cai
PI Institution: University of California - Santa Cruz

We propose deep HST/WFC3 imaging in the density peak area of BOSS1244 and BOSS1542 protoclusters at z = 2.23 traced by the strongest groups of Ly-alpha absorbers and multiple quasars in SDSS database. These two structures are selected from a large survey volume of 1 Gpc^3, and they are the most overdense and robustly established cluster-sized overdensities at z ~ 2. BOSS1244 has the overdensity of 11.0 +/- 2.0 on the 15 comoving Mpc (cMpc) scale and BOSS1542 has the overdensity of 13.0 +/- 2.0 on the 15cMpc scale, representing the most overdense environments at high redshift. Our dedicated LBT/LUCI and MMT/MMIRS observations have confirmed >100 galaxies at z=2.23 +/- 0.02 in each field, and confirmed the H-alpha emitters (H < 24.0) in these two fields, and measured the 3-D large-scale structures. Furthermore, these two fields are covered with complete wavelength observations from U-band to K-band using ground-based imaging. In Cycle-25, we propose to use eight HST/WFC3 pointings to cover the most overdense regions in each field. We will measure the detailed rest-frame optical morphology of for 78 member galaxies in BOSS1244 and 85 member galaxies in BOSS1542. These observations will determine whether the universal morphology-density relationship observed in the low-redshift Universe is already in place in and around most overdense region at z ~ 2. Combining the new HST observations with the existing multi-wavelength imaging ranging from 0.3 - 2.3 microns, optical spectroscopy, and narrow-band imaging, we will provide a robust sample of galaxies in the most massive protocluster at z=2 which could be evolved into the most massive galaxy clusters (10^{15} M_{sun}) in later epoch.
Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15330
Program Title: The Emergence of Star Clusters

Principal Investigator: Daniela Calzetti
PI Institution: University of Massachusetts - Amherst

We propose to measure the timescale for the clearing of natal dust by young star clusters. We will augment existing archival UV-to-I imaging data with new WFC3/IR images at J, H, and Paschen-beta for a sample of six nearby star forming galaxies. Under the standard scenario that the clearing is performed by supernovae (> 3 Myr), simulations show that not enough ionizing photons can escape galaxies and reionize the Universe at z>6. However, the actual clearing timescale is poorly established. We will obtain accurate ages and extinctions for the embedded and emergent young clusters in our target galaxies, in order to: (1) determine whether dust clearing occurs before or after 3 Myr, (2) investigate environmental dependencies for the timescale, and (3) establish the principal mechanisms for enabling the escape of ionizing photons from galaxies. Our project provides the physical footing for future JWST observations aimed at determining the sources of reionization of the Universe. The combination of archival and new images will also equip the community with a lasting legacy of homogeneous UV-to-IR coverage for a sample of nearby galaxies.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Galaxies and the IGM  
ID: 15253  
Program Title: The nature of ultra-massive lens galaxies  

Principal Investigator: Raoul Canameras  
PI Institution: University of Copenhagen, Niels Bohr Institute

During the past decade, strong gravitational lensing analyses have contributed tremendously to the characterization of the inner properties of massive early-type galaxies, beyond the local Universe. Here we intend to extend studies of this kind to the most massive lens galaxies known to date, well outside the mass limits investigated by previous lensing surveys. This will allow us to probe the physics of the likely descendants of the most violent episodes of star formation and of the compact massive galaxies at high redshift.

We propose WFC3 imaging (F438W and F160W) of four extremely massive early-type lens galaxies at $z \sim 0.5$, in order to put them into context with the evolutionary trends of ellipticals as a function of mass and redshift. These systems were discovered in the SDSS and show one single main lens galaxy with a stellar mass above $1.5 \times 10^{12}$ Msun and large Einstein radii. Our high-resolution spectroscopic follow-up with VLT/X-shooter provides secure lens and source redshifts, between 0.3 and 0.7 and between 1.5 and 2.5, respectively, and confirm extreme stellar velocity dispersions $\approx 400$ km/s for the lenses. The excellent angular resolution of the proposed WFC3 imaging - not achievable from the ground - is the remaining indispensable piece of information to:

(1) Resolve the lens structural parameters and obtain robust measurements of their stellar mass distributions,

(2) Model the amount and distribution of the lens total masses and measure their M/L ratios and stellar IMF
Proposed Category: GO
Scientific Category: Massive Black Holes And Their Host Galaxies
ID: 15267
Program Title: HST Grism observations of the highest-z massive galaxy cluster

Principal Investigator: Rebecca Canning
PI Institution: Stanford University

We propose to observe the most massive galaxy cluster, \lssu, at a redshift of $z>2$. By observing this cluster with 12 orbits HST G141 grism and F140W filter observations plus one orbit F105W, we will be able to precisely identify cluster members, as well as study how the dense cluster environment affects these members at an unprecedentedly high redshift and minimizing biases from cluster selection. With this data set, we will examine the fraction of AGN and star forming galaxies as a function of cluster radius as well as incidences of merging, allowing key insights into the triggering and quenching mechanisms at play. Furthermore, we will examine the quiescent galaxy fraction to probe the the build-up of the red sequence at an early cosmological time. Finally, looking forward, we will use our observations to quantify the amount of star formation contamination that is likely to effect the next generation SZ surveys at other wavelengths.
Proposal Category: GO
Scientific Category: Stellar Populations
ID: 15228
Program Title: Testing Galaxy Evolution in Unexplored Environments: the First Faint Dwarf Satellites of Local Volume LMC Analogs

Principal Investigator: Jeffrey Carlin

PI Institution: Large Synoptic Survey Telescope

We propose to use four HST/ACS orbits to obtain follow-up imaging and resolved photometry of two candidate dwarf galaxies in the halos of Local Volume LMC analogs, which have been discovered as part of our ground-based MADCASH survey: MADCASH-1, which is a satellite of NGC 2403 (D = 3.2 Mpc), and MADCASH-2, near NGC 4214 (D = 2.9 Mpc). These are the faintest dwarf satellites known around host galaxies of Large Magellanic Cloud stellar mass outside the Local Group. We will measure accurate TRGB distances to confirm their associations with their host galaxies, derive their structural parameters, and assess their stellar populations. These two dwarf galaxies, the first of their kind around LMC analogs, are vital probes of dwarf evolution in different environments. Both of these MADCASH dwarfs are at luminosities intermediate between the "classical" Milky Way dwarf galaxies and the "ultra-faint" dwarfs. The proposed observations will resolve individual stars in these systems of small angular size, allowing us to quantify the relative presence of ancient stellar populations and younger, more metal-enriched stars, and to measure their physical properties. We will compare these to the Milky Way classical and ultra-faint dwarfs to place these systems in a broader context and assess similarities or differences between these "dwarfs around dwarfs" and Local Group satellites.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Planets and Planet Formation  
ID: 15301  
Program Title: Now you see me - the WASP-117b version

Principal Investigator: Ludmila Carone  
PI Institution: Max-Planck-Institut fur Astronomie, Heidelberg

WASP-117b is an unique exoplanet as it’s elliptical orbit causes the temperature of the atmosphere to cross the 970 K temperature boundary, which separates the disequilibrium and equilibrium chemistry regime. Due to the long orbital period (10.022 days) compared to chemistry and dynamical time scales and due to the orbital orientation, we can expect the planet to be well in the disequilibrium chemistry temperature regime (Teff <970 K) during transit, which is identifiable by the under-abundance of methane compared to predictions with equilibrium chemistry.

To characterize the atmosphere of WASP-117b, we thus propose to observe its primary transit with HST/WFC3. It is the only instrument currently available with sufficient stability to cover the 6 hour long, relatively deep (0.75%) transit over a quiet, bright (mv=10.14) host star and to obtain accurate transit spectroscopy to constrain methane-content in the atmosphere of WASP-117b.

Two important science objectives can thus be fulfilled with only one HST measurement: a) Determining if the planet’s atmosphere is in chemical equilibrium or not and b) Constraining the effective temperature, albedo and cloud coverage. Since the planet is expected to spend several days each in the disequilibrium and equilibrium chemistry regime over the course of one orbit, HST observations will also provide a vital first input for planning future phase resolved JWST observations. The latter will allow to investigate atmosphere and cloud composition changes as WASP-117b switches in between chemical regimes.
We propose 13 orbits of ACS and WFC3 imaging to characterize the environments of 6<z<7 quasars. These quasars are suggested to live in particularly overdense environments, given an observed excess of serendipitous millimeter continuum detections in their vicinities from ALMA. At z>6, 1.1mm probes the peak of dust emission and is a good proxy for total obscured SFR; the serendipitous ALMA detections we find are consistent with SFRs 30-150Msun/yr, and they are likely to sit at the same redshift of the quasar because they greatly exceed the expected number of detections for blank-field millimeter work. We will use HST imaging to investigate whether or not these are genuine overdense environments by identifying candidate star-forming galaxies via their Ly-alpha break and rest-frame UV continuum. The ALMA data enables us to place unique constraints on the assembly history of early Universe protoclusters, given the short duty-cycle of dusty galaxies detected directly in the millimeter. This will allow us to directly characterize the luminosity functions in overdense environments at z>6, characterizing the ubiquity of starbursts around quasars, and test the predictions of theory, which assert that half of all cosmic star-formation at z>6 takes place in overdense environments that will eventually collapse into >10^{14}Msun galaxy clusters at z=0.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Massive Black Holes And Their Host Galaxies
ID: 15331
Program Title: Multi-Wavelength Spectroscopy of Tidal Disruption Flares: A Legacy Sample for the LSST Era

Principal Investigator: Stephen Cenko

PI Institution: NASA Goddard Space Flight Center

When a star passes within the sphere of disruption of a massive black hole, tidal forces will overcome self-gravity and unbind the star. While approximately half of the stellar debris is ejected at high velocities, the remaining material stays bound to the black hole and accretes, resulting in a luminous, long-lived transient known as a tidal disruption flare (TDF). In addition to serving as unique laboratories for accretion physics, TDFs offer the hope of measuring black hole masses in galaxies much too distant for resolved kinematic studies.

In order to realize this potential, we must better understand the detailed processes by which the bound debris circularizes and forms an accretion disk. Spectroscopy is critical to this effort, as emission and absorption line diagnostics provide insight into the location and physical state (velocity, density, composition) of the emitting gas (in analogy with quasars). UV spectra are particularly critical, as most strong atomic features fall in this bandpass, and high-redshift TDF discoveries from LSST will sample rest-frame UV wavelengths.

Here we propose to obtain a sequence of UV (HST) and optical (Gemini/GMOS) spectra for a sample of 5 TDFs discovered by the Zwicky Transient Facility, doubling the number of TDFs with UV spectra. Our observations will directly test models for the generation of the UV/optical emission (circularization vs reprocessing) by searching for outflows and measuring densities, temperatures, and composition as a function of time. This effort is critical to developing the framework by which we can infer black hole properties (e.g., mass) from LSST TDF discoveries.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Galaxies and the IGM  
ID: 15163  
Program Title: COS Ultraviolet Baryon Survey (CUBS)  

Principal Investigator: Hsiao-Wen Chen  
PI Institution: University of Chicago

The cosmic star-formation-rate density declines rapidly from z~1.5 to the present day. Observing the co-evolution of galaxies and their surrounding gas during this epoch provides key insights into how galaxy growth is regulated by accretion and outflows. We propose the COS Ultraviolet Baryon Survey (CUBS) project to map gas flows in and out of the circumgalactic medium at intermediate redshifts using absorption line spectroscopy of 15 QSOs at z_qso=0.8-1.3. CUBS will bridge the gap between existing efforts at z<0.4 and at z~2, solidify a foundation for z>4 studies in the JWST era, and greatly enhance HST’s UV spectroscopic legacy with a three-fold increase in high-quality UV absorption spectra at z_qso>0.8. Over the range of z=0.4-0.8, absorption measurements of both low- and high-ions (i.e. C, O, Si, Ne), together with accurate measurements of HI column density from multiple Lyman series transitions, enable robust measurements of the ionization state and metallicity of the gas. All of the proposed QSOs are in the Dark Energy Survey, providing deep, multi-color images of the galactic environments of the absorption systems. We will obtain follow-up spectroscopy of the QSOs and complete spectroscopic redshift surveys of the galaxies in the foreground volume. CUBS will 1) provide a census of the chemical enrichment of the CGM/IGM over cosmic time, 2) assess its relationship to galaxies at various stages of evolution, and 3) inform and refine galactic feedback prescriptions in cosmological simulations. This project exploits a synergy between UV spectroscopy and ground-based wide-field survey data to advance our understanding of the cosmic evolution of baryonic structures.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Massive Black Holes And Their Host Galaxies
ID: 15254
Program Title: The host galaxy of the gravitational wave recoiling black hole candidate 3C186

Principal Investigator: Marco Chiaberge
PI Institution: Space Telescope Science Institute - ESA

We discovered a gravitational wave (GW) recoiling black hole (BH) candidate in our HST WFC3 snapshot images of the radio-loud QSO 3C186. These events are expected to happen as a result of BH-BH mergers. This extremely energetic phenomenon leads to the production of an intense field of GWs, which in most cases are emitted anisotropically. As a result, the merged black hole may receive a kick and be displaced from the center of the host galaxy with velocities that can be as high as ~4000 km/s. Depending on the relative orientation of the kick with respect to the line-of-sight, if the BH is active we expect to observe an offset QSO. Furthermore, the broad lines may be offset with respect to the narrow lines, which are emitted in the frame of the host. 3C186 shows all of the predicted observational features of a such an event. Spectra show offsets between narrow and broad emission lines of ~2100km/s, and our HST image clearly shows that the QSO is offset by 1.3" with respect to the isophotal center of the host galaxy. Scenarios alternative to the GW kick as the origin for the observed features are unlikely, but still viable. Only HST allows us to obtain spatially resolved information, high sensitivity and stable PSF to better investigate the host galaxy properties. We will use ACS and WFC3 to obtain deep images and study the morphology of the host galaxy. We will unambiguously establish whether the host galaxy of 3C186 underwent a major merger and we will be able to set accurate constraints on the age of the merger. The proposed observations will have a tremendous impact on our knowledge of supermassive BH mergers and the associated emission of gravitational waves.
Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15099
Program Title: Do galactic outflows shape the stellar mass-metallicity relationship?

Principal Investigator: John Chisholm
PI Institution: Observatoire de Geneve

Dwarf galaxies have substantially fewer metals, relative to hydrogen, than their high-mass counterparts. This relationship is called the stellar mass-metallicity relationship, and it is astonishingly tight at nearly all redshifts. The metallicities of dwarf galaxies are lower than expected from a 'closed-box' model, where galaxies retain all of the metals produced by stars. Theory suggests that dwarf galaxies preferentially eject metals through metal-enriched galactic outflows to create the observed relationship between stellar mass and metallicity. However, this has yet to be confirmed observationally. Recently, we characterized the cool ionized gas in galactic outflows in seven star-forming galaxies using COS ultraviolet spectroscopy. Using multiple absorption lines and photoionization models, we measure the outflow metallicities of these seven galaxies using a Bayesian approach. The outflow metallicities suggest that low-mass galaxies eject a larger fraction of their metals than high-mass galaxies do, in agreement with the requirements from the observed stellar mass -- gas fraction --metallicity relationship. Unfortunately, the current COS archive only contains two galaxies within the steep portion of the mass-metallicity relationship, rendering these conclusions tentative. Here, we propose new COS spectroscopic observations of eight low-mass galaxies to measure their mass outflow rates and outflow metallicities. These observations will determine the role of galactic outflows in establishing the observed mass-metallicity relationship, uncovering the origin of one of the defining relationships in extragalactic astronomy.
Proposal Category: GO
Scientific Category: Planets and Planet Formation
ID: 15218
Program Title: Debris Disk Dust Characterization through Spectral Types: Deep Visible-Light Imaging of Nine Systems

Principal Investigator: Elodie Choquet
PI Institution: Jet Propulsion Laboratory

We propose STIS coronagraphy of 9 debris disks recently seen in the near-infrared from our re-analysis of archival NICMOS data. STIS coronagraphy will provide complementary visible-light images that will let us characterize the disk colors needed to place constraints on dust grain sizes, albedos, and anisotropy of scattering of these disks. With 3 times finer angular resolution and much better sensitivity, our STIS images will dramatically surpass the NICMOS discovery images, and will more clearly reveal disk local structures, cleared inner regions, and test for large-scale asymmetries in the dust distributions possibly triggered by associated planets in these systems. The exquisite sensitivity to visible-light scattering by submicron particles uniquely offered by STIS coronagraphy will let us detect and spatially characterize the diffuse halo of dust blown out of the systems by the host star radiative pressure. Our sample includes disks around 3 low-mass stars, 3 solar-type stars, and 3 massive A stars; together with our STIS+NICMOS imaging of 6 additional disks around F and G stars, our sample covers the full range of spectral types and will let us perform a comparative study of dust distribution properties as a function of stellar mass and luminosity. Our sample makes up more than 1/3 of all debris disks imaged in scattered light to date, and will offer the first homogeneous characterization of the visible-light to near-IR properties of debris disk systems over a large range of spectral types. Our program will let us analyze how the dynamical balance is affected by initial conditions and star properties, and how it may be perturbed by gas drag or planet perturbations.
Proposal Category: AR
Scientific Category: Galaxies and the IGM
ID: 15011
Program Title: The Baryon Cycle through Cosmological Simulations: Taking COS to the Next Generation of Analysis

Principal Investigator: Christopher Churchill

PI Institution: New Mexico State University

How do baryons cycle in and out of galaxies, and how does the baryon cycle drive galaxy evolution? Stellar feedback processes and accretion from the intergalactic medium give rise to extended metal-enriched gaseous structures surrounding galaxies: the circumgalactic medium (CGM). Arguably, the CGM is the key component of the baryonic cycle that regulates galaxy evolution and is therefore the most critical component of the cycle to pin down. COS was developed primarily for this purpose and 100s of HST orbits have been dedicated to CGM observations. However, high resolution hydrodynamic simulations show that standard observational analysis methods of absorption lines are fraught with assumptions that are no longer justified. We aim to address this, thereby increasing the intrinsic scientific value of archived HST/COS spectra.

We propose to enhance the legacy of HST/COS by analyzing Eulerian hydrodynamic cosmological simulations incorporating physics based baryon cycle processes. We will (1) undertake absorption line analysis of simulated galaxies that accurately emulates observational data and analysis methods and compare the results to published COS programs, (2) compare the 3D simulations to the absorption line results, (3) assess commonly applied absorption line methods in order to provide insights into the interpretation of HST/COS data, and (4) develop new absorption line analysis methods that better reflect the CGM gas spatial and kinematic distributions.

Our goal is to provide deeper insights into current observational techniques for improving our observational knowledge of the baryon cycle from COS spectra.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Galaxies and the IGM  
ID: 15268  
Program Title: A First Investigation of the UV Extinction Properties of Interstellar Dust in M33

Principal Investigator: Geoffrey Clayton  
PI Institution: Louisiana State University and A & M College

It is well known that the standard Milky Way UV extinction curve does not hold even in the most nearby galaxies, the LMC and the SMC. But, it is not even known whether the standard curve holds throughout our own galaxy because our position in the disk of the Milky Way, where extinction is high, prevents us from seeing most of our galaxy at UV wavelengths. We have a unique opportunity, while we still have the capability to obtain UV spectra, to investigate the UV extinction properties across another spiral galaxy in the Local Group, M33. The small aperture and high sensitivity of HST/STIS are ideal for obtaining UV spectra of stars in the crowded fields of M33. We propose to observe 8 stars in M33 which will provide good spatial coverage. We are choosing sightlines that lie in the footprint of the M33 Legacy Survey which extends the Panchromatic Hubble Andromeda Treasury (PHAT) survey. Focusing our study on the detailed properties of M33 dust grains via UV spectroscopy with HST/STIS will mean that we can directly connect the variations seen in the UV extinction curves with their environments. By selecting our sightlines in the M33 PHAT survey region, we will be able to probe a variety of potential correlations between dust grains and their environment. This proposal is part of a long-term program to investigate the extinction properties of interstellar dust across a sample of Local Group galaxies, also including M31, with different global characteristics such as metallicity and star formation activity. There is a metallicity gradient across M33 from solar to sub-solar that will be sampled with our proposed sightlines.
Proposal Category: GO
Scientific Category: Stellar Populations
ID: 15065
Program Title: Opening the Window on Galaxy Assembly: Ages and Dynamics of Inner Milky Way Globular Clusters

Principal Investigator: Roger Cohen
PI Institution: Space Telescope Science Institute

We propose a systematic investigation of the ages and dynamics of the Galactic globular clusters (GGCs) located in the inner Milky Way. By targeting bulge GGCs that have a first epoch of deep archival ACS/WFC or WFC3/UVIS imaging and obtaining a second epoch of deep (S/N>100 at the main sequence turnoff) ACS/WFC F606W, F814W imaging, we will exploit 7-14 year time baselines to measure precise (<0.5 Gyr) relative ages from proper motion (PM) cleaned color-magnitude diagrams.

Archival imaging confirms that our target clusters occupy a unique location in GGC parameter space with regard to location, concentration, metallicity and HB morphology. Therefore, the proposed observations allow the first study of a statistically-significant sample of GGCs in the regime of strong disk/bulge shocking with regard to both ages and dynamics. Specifically, by simultaneously measuring ages and proper motions, we may perform a direct, self-consistent empirical comparison at fixed metallicity between our target clusters and well-studied Treasury Survey (GO-10775) GGCs with known ages and orbits to test the following recent hypotheses:

1) Present day GGCs close to the Galactic center (R<3 kpc) formed in situ.

2) Location in the GGC age-metallicity plane is determined by progenitor mass.

3) Metal-intermediate blue horizontal branch GGCs in the bulge are as old as their ancient metal-poor halo
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Stellar Populations  
ID: 15302  
Program Title: Unveiling the formation of Andromeda XIX - a uniquely diffuse Local Group galaxy  

Principal Investigator: Michelle Collins  
PI Institution: University of Surrey

We request 16 orbits of HST/ACS to obtain imaging in F606W and F814W of Andromeda (And) XIX, a truly unique galaxy. With an effective radius of 3.1 kpc, and a surface brightness of 29.3 mag per square arcsec, it is the only known Local Group analogue of the intriguing newly-discovered ultra diffuse galaxies found at higher redshift. And XIX contains significant substructure, and is one of only 3 low mass galaxies that is known to have prolate rotation. This suggests the possibility that And XIX formed as the result of a merger. Using deep, coordinated parallel HST/ACS and WFC3 imaging, we will efficiently test this formation scenario. Our proposed observations will allow us to measure detailed star formation histories for both the centre of And XIX, and its most significant substructure, the southern clump.

If And XIX has been formed as the result of a merger, we expect to see significant differences between the star formation histories of both fields. If And XIX has formed through secular processes or tidal stripping, we expect to see no difference between the two fields. Either result will place a strong constraint on the formation of And XIX, and therefore also the most diffuse galaxies known.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Planets and Planet Formation
ID: 15255
Program Title: The KELT-11b Opportunity: Measuring the Atmospheric Water Abundance for a Sub-Saturn-Mass Planet around a Metal-Rich Star

Principal Investigator: Knicole Colon

PI Institution: NASA Goddard Space Flight Center

Measurements of exoplanet atmosphere composition provide an unparalleled window into planetary nature and origins. Water in particular is an important tracer of the planet formation process because it is a dominant component by mass of icy planetesimals. Exoplanets provide the opportunity to measure water abundance over a wide range of planet masses and thereby test predictions of planet population synthesis models. So far, however, precise constraints on water abundance have been limited to Jupiter-mass objects.

Here we propose to measure the transmission spectrum of the recently discovered low density sub-Saturn KELT-11b with HST/WFC3. We will use this measurement to determine the planet's atmospheric water abundance. KELT-11b is one of the few Saturn-mass planets for which we can obtain constraints on the water abundance with a modest amount of telescope time. Our results will enable meaningful comparison with both objects in the Solar System and with the other few planets in the sub-Saturn population. This program will also be the first investigation of the metal enhancement of a planet with a metal-rich host star. Even if the atmosphere is cloudy, our data will be sufficiently precise to detect water above a 1 mbar cloud-deck, and will constrain cloud physics in a new regime of surface gravity. These measurements will set the stage for comparative planetology that will be possible with JWST.
Proposal Category: GO
Scientific Category: Cosmology
ID: 15198
Program Title: UV Observation of a QSO Sightline Intersecting an X-ray Identified Filament of the Cosmic Web

Principal Investigator: Thomas Connor
PI Institution: Carnegie Institution of Washington

We propose to observe Quasar QSO J0102-2209 with COS for 5 orbits to study the multi-phase nature of a filament detected in X-rays connecting to Abell 133. The diffuse nature of cosmic filaments makes detecting them in X-rays an almost impossible task with current X-ray observatories without dedicating extreme amounts of time; this filament was detected with almost a month of total observations with Chandra. As the only known quasar intersecting a reported X-ray filament, QSO J0102-2209 offers us the unique opportunity to study the multi-phase conditions of a filament with both UV and X-ray observations. With the observations we propose, we will use Lyman-alpha absorption to detect neutral hydrogen down to a column density of N(HI) ~ 10^{13.3} cm^{-2}. Additionally, we will use low- and intermediate-ionization metal transition lines to constrain the metallicity and ionization state of the filamentary gas.
Proposal Category: GO  
Scientific Category: Galaxies and the IGM  
ID: 15100  
Program Title: Mapping the escaping ionizing flux of Lyman continuum galaxies

Principal Investigator: Jeff Cooke  
PI Institution: Swinburne University of Technology

We propose WFC3 imaging to map the origin and extent of escaping ionizing (< 912 A) flux for \( \sim 50 \ z \sim 3-4 \) Lyman continuum galaxies (LCGs) in the COSMOS field. LCGs are a recently identified population of galaxies selected via 30-band photometry and deep spectroscopy that exhibit excess Lyman continuum (LyC; < 912 A) flux. In this program, we will observe 2 WFC3 pointings to gather a statistical sample of the the full population. The data will (1) map the full LyC flux extent and origin, (2) measure the LyC flux as a function of galaxy luminosity, morphology, UV continuum slope, and Lyα emission for the spectroscopic subset, and (3) secure the number density of this newly identified population of galaxies. This is the first systematic investigation of a \( z = 3-4 \) galaxy population analog to \( z > 6 \) galaxies responsible for cosmic reionization. LCG ionizing flux measurements will be used with our Keck/MOSFIRE restframe optical spectroscopic program to calibrate models that predict the escaping ionizing photon fraction based on nebular emission line strength ratios. The method will be used to infer galaxy ionizing photon escape fractions near, and beyond, the epoch of reionization using JWST, as direct measurements of < 912A photons at \( z > 5 \) are impossible as a result of IGM absorption. Complete LyC flux measurements, including the full extent and physical origin of the ionizing flux for proper calibration of the models at \( z \sim 3-4 \) can only be done with HST imaging.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: AR
Scientific Category: Galaxies and the IGM
ID: 15012
Program Title: Resolving the Small-Scale Structure of the Circumgalactic Medium in Cosmological

Principal Investigator: Lauren Corlies
PI Institution: The Johns Hopkins University

We propose to resolve the circumgalactic medium (CGM) of L* galaxies down to 100 Msun (250 pc) in a full cosmological simulation to examine how mixing and cooling shape the physical nature of this gas on the scales expected from observations. COS has provided the best characterization of the low-z CGM to date, revealing the extent and amount of low- and high-ions and hinting at the kinematic relations between them. Yet cosmological galaxy simulations that can reproduce the stellar properties of galaxies have all struggled to reproduce these results even qualitatively. However, while the COS data imply that the low-ion absorption is occurring on sub-kpc scales, such scales can not be traced by simulations with resolution between 1-5 kpc in the CGM. Our proposed simulations will, for the first time, reach the resolution required to resolve these structures in the outer halo of L* galaxies.

Using the adaptive mesh refinement code enzo, we will experiment with the size, shape, and resolution of an enforced high refinement region extending from the disk into the CGM to identify the best configuration for probing the flows of gas throughout the CGM. Our test case has found that increasing the resolution alone can have dramatic consequences for the density, temperature, and kinematics along a line of sight. Coupling this technique with an independent feedback study already underway will help disentangle the roles of global and small scale physics in setting the physical state of the CGM. Finally, we will use the MISTY pipeline to generate realistic mock spectra for direct comparison with COS data which will be made available through MAST.
Proposal Category: GO
Scientific Category: Stellar Populations
ID: 15332
Program Title: Unveiling the extreme nature of the hyper faint galaxy Virgo I

Principal Investigator: Denija Crnojevic
PI Institution: Texas Tech University

We request HST/ACS imaging to obtain a deep color-magnitude diagram of the newly discovered candidate Milky Way satellite Virgo I. With an estimated absolute magnitude of only $M_V$~\textasciitilde 0.8 and a Galactocentric radius of $\sim$90 kpc, Virgo I is one of the faintest and most distant dwarfs ever observed, and could be identified as a prototype ``hyper'' faint galaxy. The detailed characterization of the smallest inhabited dark matter subhalos is crucial to guide hierarchical galaxy formation models, and in particular to constrain reionization, the nature of the dark matter particle, etc. With the advent of deep wide-field, ground-based surveys, the potential of uncovering these lowest-mass galaxies is quickly turning into reality, as demonstrated by the discovery in the past two years of tens of new Local Group members in the ultra-faint regime ($M_V$ \textasciitilde -8). Virgo I represents a new record in galaxy physical properties, and urges us to be prepared for the likely emergence of an entirely new class of such objects in the era of future wide-field surveys (e.g., LSST). Only high resolution HST observations can enable us to confirm the nature of Virgo I, providing significantly more accurate estimates for its distance and structural properties, when compared to the discovery Subaru/HyperSuprimeCam imaging. Our proposed dataset will constitute a fundamental step in the upcoming hunt for galaxies with similarly extreme properties.
Proposal Category: GO
Scientific Category: Planets and Planet Formation
ID: 15333
Program Title: The Atmospheric Diversity of Mini-Neptunes in Multi-planet Systems

Principal Investigator: Ian Crossfield
PI Institution: University of California - Santa Cruz

Mini-Neptunes, planets 2-4 times the size of the Earth, are an intriguing population. They are an abundant outcome of planet formation and occur around more than a quarter of all stars — yet they are absent in the Solar System. Mini-Neptunes bridge the gap between terrestrial planets and gas giants, and atmosphere characterization of these planets has much to reveal about their current properties, origins, and evolutionary histories. However, only a handful of mini-Neptunes have been amenable to atmospheric study so far.

We propose a survey of four mini-Neptunes recently discovered by our team around bright, nearby stars. These observations will nearly double the number of planets in this size range with measured transmission spectra. Our observations will yield high-precision constraints on the planets’ atmospheric metallicities, elemental abundances, C/O ratios, and aerosol content. With a greatly expanded mini-Neptune sample, we will identify trends in planet properties as a function of equilibrium temperature, UV irradiation, planet mass, and stellar spectral type. These trends will also identify specific promising targets for further study with JWST, and will help us
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Stellar Physics  
ID: 15269  
Program Title: Boron in Hyades F Dwarfs - Tracing Deep Into the Li-Be Gap

Principal Investigator: Jeffrey Cummings  
PI Institution: The Johns Hopkins University

Dramatic deficiencies of Li in the mid-F stars of the Hyades cluster were discovered by Boesgaard and Tripicco in 1986. Using high-resolution, high signal-to-noise spectra from the Keck 10-m telescope, Boesgaard and King discovered the corresponding deficiencies in Be in the same narrow temperature region in the Hyades. We propose an investigation into the B abundance in the Hyades F stars to ascertain if there is also a B gap. Boron can only be observed with HST; we plan to use the resonance line of B I at 2497 Angstroms. Each of these three elements is destroyed inside stars, but at different depths. Li, Be, and B survive to progressively greater depths, and their surface abundances act as a report on the depth and thoroughness of physical processes occurring in the star. The Li-Be gaps strongly contradict standard theory. Previous work favors rotational mixing that results from angular momentum loss as the dominant mechanism over diffusion, mass loss, and other types of rotational mixing. However, combinations of these mechanisms or other possibilities could still be at work. These observations will help determine the nature of the mixing mechanism(s) and the connection to stellar rotation. The abundance of *all three* light elements in a cluster of known age and metallicity can provide the information needed to discern internal stellar processes. The Li and Be deficiencies occur in field and cluster stars in this mass range (1.1 - 1.25 solar masses), but the mechanisms can best be studied in a cluster of stars of common origin and known characteristics. The Hyades cluster at 650 Myr is close enough to contain stars bright enough for this investigation.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: AR
Scientific Category: Cosmology
ID: 15013
Program Title: Interpreting HST observations with simulations of reionization: the ionizing photon budget and the decline of Lyman-alpha emission in z>6 dropouts

Principal Investigator: Anson D'Aloisio

PI Institution: University of Washington

In recent years, HST surveys such as CANDELS, HUDF, BoRG/HIPPIES, ERS, and the Frontier Fields, have made possible the first robust measurements of the rest-frame UV luminosity function of z =6-10 galaxies, spanning much of the redshift range over which reionization likely occurred. These measurements provide an estimate of the galactic ionizing photon output, addressing the critical question of whether these galaxies could have reionized the Universe. In addition, follow-up spectroscopy has measured the fraction of these galaxies that show Lyman-alpha emission. Interestingly, a dramatic decrease in this fraction above z~6 has been observed, and this evolution has (controversially) been interpreted as evidence that much of reionization happened over z=6-8 (as intergalactic neutral gas leads to large damping wings that scatter the Lyman-alpha line). The clumpiness of the IGM and how it self shields to ionizing photons impacts whether the observed population of galaxies can reionize the Universe, as well as the interpretation of the evolving Lyman-alpha emitter fraction. We propose to run fully coupled radiative-hydrodynamics simulations that are the first to resolve the evaporation of small structures by passing ionization fronts and, hence, to accurately assess the level of clumpiness and self-shielding from the IGM. Our study will nail down the "clumping factor" used to assess whether the observed population of galaxies can drive reionization, and it will address whether neutral self-shielding clumps in recently reionized regions can scatter galaxies' Lyman-alpha lines.
Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15303
Program Title: Revealing the Environmental Dependence in Superluminous Supernovae Diversity

Principal Investigator: Chris D'Andrea
PI Institution: University of Pennsylvania

Superluminous Supernovae (SLSNe) are a rare, exotic new class of transients, 50 times brighter than classical supernovae, that have only been identified within the past decade. Little is known about the nature of the progenitors of these massive explosions. To date fewer than 100 of these have been discovered, and most have single-band photometry, poor light-curve coverage, and are at low to moderate redshift. The Dark Energy Survey (DES) has spectroscopically-classified 17 SLSNe from 0.2 < z < 2.0, all of which have well-cadenced griz photometry spanning the entirety of the 5.5 month DES observing season. While the data quality is uniformly excellent, the variability in the SLSNe themselves is remarkable: the rise time, the decline rate, and the peak magnitudes all exhibit large variations. Here we propose to obtain rest-frame NUV photometry to probe the environment of SLSNe discovered in DES. We will determine the local and global star-formation rates (SFRs), and morphology and compactness of the galaxy. These observations will double the existing sample of SLSNe at z>0.5 for which these host-galaxy properties can be determined. We will then use this information to conduct the first systematic study of host-galaxy correlations with SLSN light-curve properties. By tying environmental constraints to observed characteristics of the explosion, this study will get to the heart of the SLSN progenitor question.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Stellar Populations  
ID: 15334  
Program Title: Towards high accuracy tests on the substellar IMF in young clusters. A survey in NGC 2024.

Principal Investigator: Nicola Da Rio  
PI Institution: University of Florida

Measuring the Initial Mass Function in young clusters, and testing its universality, is a fundamental benchmark to constrain the physical processes and theoretical models of star formation. The shape and universality of the stellar IMF are well known. Our observational characterization of the substellar IMF, on the other hand, remains more uncertain, along with its possible environmental variations. 

Because of this, the physical processes that play a role in the formation of brown dwarfs are not fully constrained. In Cycle 22 we were awarded HST time to carry out the deepest spectro-photometric census of BDs in a young cluster: the Orion Nebula Cluster. Through deep WFC3/IR narrow band imaging, we are able to obtain Teff and A_V down to ~15M_jup. Preliminary analysis limited to a portion of the total field of view allows us to classify several hundreds BDs, place them in the HRD and obtain, for an extinction limited sample, the complete and consistent IMF down to planetary masses. The substellar slope is consistent with the Galactic IMF but a rapid drop is found at the H-burning limit. We propose to carry out a nearly identical survey with HST in a younger, less massive nearby cluster: NGC2024 in the Flame Nebula. This will allow us to derive the complete census of the young population down to planetary masses, derive the IMF, enabling a consistent comparison with the results in the ONC. We will specifically look for statistically significant IMF variations with environmental properties (cluster mass, density) and investigate primordial mass segregation in the substellar regime. These results will significantly help to constrain the mechanisms involved in BD formation.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Galaxies and the IGM  
ID: 15229  
Program Title: Spectroscopic redshifts and age dating of a first statistical sample of passive galaxies at z~3

Principal Investigator: Emanuele Daddi  
PI Institution: Commissariat a l’Energie Atomique (CEA)

Ultradeep WFC3/G141 observations from one of our past HST programs allowed us to confirm the redshift and measure the age of a quiescent galaxy at z=3. This unique object was found inside a single WFC3 pointing (4 sq. arcmin) suggesting that massive old galaxies even at z~3 are more common than previously thought. The strong correlation observed between evolved stellar populations and a bulge-dominated morphology at least up to z~2 may also imply that the Hubble sequence comes into place at very early times. Guided by the properties of this spectroscopically confirmed z=3 passive galaxy, we have identified a substantial sample of 2.5<z<3.5 passive candidates over the full COSMOS field, selecting the brightest, most massive and most secure targets for which sufficient S/N on the continuum can be obtained in ~2 orbits with WFC3/G141 grism spectroscopy. We request here a total of 17 orbits to observe a sample of 10 passive galaxies at z>2.5, to detect their 4000Å breaks and measure precise redshifts, confirming their identification as distant, quiescent systems (as opposed to dusty star-forming sources), and measuring their stellar ages as well as sizes from the WFC3/F140 ancillary imaging. We have verified that no object of this kind, bright enough to be confirmed spectroscopically, can be found inside existing WFC3 spectroscopy in the CANDELS fields, and that this science cannot be competitively done from the ground. These new observations will push the constraints on the evolution, nature and abundance of passive galaxies to the highest redshifts, and will allow a first detailed picture of the early assembly of the Hubble sequence.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15101
Program Title: A high-definition study of the brightest lensed galaxy in the universe

Principal Investigator: Haakon Dahle
PI Institution: University of Oslo

We propose ACS/WFC3 broad-band and medium-band imaging and WFC3/IR grism spectroscopy of a uniquely bright (R=17.8) star forming galaxy at z=2.37. This target is likely to be the brightest lensed galaxy that will ever be discovered. The galaxy is gravitationally lensed into a 55'' long arc, with a total magnification factor most likely in excess of 50x. The proposed observations will be used to construct a lensing mass model to precisely measure the lensing magnification at each location along the arc. This will allow us to probe the spectral energy distributions, star formation rates, metallicities and ionization parameters of individual star forming regions, while also mapping the relative distribution of Lyα emission and stellar UV continuum on scales down to <100 pc. The spatial resolution of HST is required to reveal the unprecedented amount of information available for a galaxy seen at the star-formation peak epoch of the universe.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15102
Program Title: The Super-Remnant of the Recurrent Nova M31N 2008-12a - A Signpost to Type Ia Supernovae?

Principal Investigator: Matt Darnley
PI Institution: Liverpool John Moores University

M31N 2008-12a is the single most important nova system in M31. With an unprecedented 9 observed eruptions in just 9 years, an ultra-high mass white dwarf, a high accretion rate, and low ejected mass, it is the leading pre-explosion Supernova Type Ia progenitor candidate in any galaxy. Our team uncovered a vast elliptical nebula, centred on the nova - a recurrent nova 'super-remnant', the relic of many thousands of past eruptions. State-of-the-art 'multi-cycle' nova eruption models have shown that a CO WD in a short-recurrence period nova does indeed grow towards the Chandrasekhar mass. Such models predict frequent He-flashes, ejecting significantly more mass at higher velocities, every few-hundred eruptions. Our Cycle 24 Halpha observations confirmed the association between the recurrent nova and its super-remnant, enabled the mapping of the gas density, and provided the first possible evidence of the proposed recurrent He-flashes - large scale 'ripples' in the super-remnant. We propose to utilize the unique high-spatial resolution capabilities of HST at visible wavelengths to obtain a series of deep [S II] images to: (i) uniquely trace the remnant shock structure; (ii) confirm the detection of the signature ripples laid down in the super-remnant by the recurrent He-flashes, hence (iii) constrain models of the super-remnant, allowing extrapolation to other systems, and (iv) validate long-term nova eruption models, and also (v) explore shaping mechanisms both by the nova process and surrounding ISM. The relics of He-flashes within the super-remnant would confirm the new single-degenerate WD growth model, providing crucial evidence in support of the nova pathway to SNe Ia.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15066
Program Title: Mapping the structure and kinematics of NGC 1624-2’s giant magnetosphere

Principal Investigator: Alexandre David-Uraz
PI Institution: University of Delaware

We propose to obtain phase-resolved COS observations of the extraordinary magnetic star NGC 1624-2, which has the strongest magnetic field ever detected in an O-type star, by nearly an order of magnitude. Two COS observations, obtained at rotational phases when the magnetic field is closest to pole-on and equator-on, respectively, revealed a remarkable variation of the wind line profiles, caused by the magnetically-imposed break of spherical symmetry in the kinematics, density, and ionization structure of the stellar wind. With 4 new observations, we will now monitor the variation of the UV line profiles over the whole stellar rotation to map the complex structure of NGC 1624-2's enormous magnetosphere, which represents a new regime of extreme wind confinement that will test the limits of the current theory of magnetized stellar winds.
Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15067
Program Title: Eta Carinae's Change of State: The End Game

Principal Investigator: Kris Davidson
PI Institution: University of Minnesota - Twin Cities

Eta Car is the only giant-eruption survivor that can be observed well. Hence it is genuinely unique for testing instability theories which are crucial for very massive stars. Fortuitously, a rapid change of state began about 1998. This represents an unexpected stage in the recovery following the Great Eruption ("supernova impostor event") seen 170 years ago. Now there are reasons to think that the change of state is nearly complete. HST/STIS has been the main source of information on this phenomenon, and is the only instrument that can show the final (or nearly final) state. Therefore we propose to complete this record in Cy 25. The archival value is very high, because similar observations will later be impossible; the star is changing irreversibly.

HST is needed, because UV is essential and because all ground-based spectroscopy of eta Car is heavily contaminated by emission lines formed about 0.3 arcsec away. For this object each HST orbit produces many high-quality spectra. The same data apply to other problems, e.g. exotic emission processes in the ejecta, bipolar structures, and the nature of the companion star.

We propose STIS observations: (1) A final update of the central star's wind spectrum at selected NUV-to-red wavelengths. (2) Brief UV spectroscopy with the MAMA echelle. This will be the only such data obtained at a time when the companion star is near apoastron. (3) Special sampling of the Homunculus ejecta-nebula using STIS/CCD with long exposure times. This was done once before, in 2000, and major changes have occurred since then.
Proposal Category: AR
Scientific Category: Galaxies and the IGM
ID: 15014
Program Title: New Constraints on the Hard Ionizing Photon Budget and the Lifetime and Obscuration of Quasars During the Epoch of Helium Reionization

Principal Investigator: Frederick Davies
Pl Institution: University of California - Santa Barbara

The epoch of helium reionization was a major milestone in the history of the Universe, a direct consequence of supermassive black hole growth and the cumulative output of hard ionizing photons by quasars. Our observations of the He II Ly-alpha forest with HST/COS in 26 quasar sightlines show strong fluctuations at z ~ 3, consistent with our state-of-the-art simulations of the He II reionization epoch. However, our detection of transmission at z > 3.5 is inconsistent with all He II reionization models. Resolving this puzzle requires an extensive parameter study of He II reionization, which we propose to carry out using our fast, efficient simulations. The He II Ly-alpha forest is also sensitive to the effect of quasar radiation illuminating the intergalactic medium, known as the proximity effect. We have performed an ambitious ground-based imaging and spectroscopic survey for z ~ 3 quasars in the foreground of HeII sightlines observed with HST/COS, and statistically detected the transverse proximity effect for the first time. The strength of this effect depends on both the quasar lifetime and the opening angle of quasar emission (or the fraction of obscured quasars), and we propose to use our He II reionization simulations to interpret this new measurement. Finally, the line-of-sight proximity effect due to the background quasar provides an independent constraint on the quasar lifetime. Our preliminary comparison of He II spectra to our radiative transfer simulations suggests a quasar lifetime > 10 Myr. We propose to use our He II reionization simulations to model this diverse set of observations and fully capitalize on the far-UV legacy of HST.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15103
Program Title: Beacons in the dark: using the most distant galaxies to probe cosmic reionization

Principal Investigator: Stephane De Barros
PL Institution: Observatoire de Geneve

One of the major unresolved problems in modern cosmology is when and how the universe was ionized. The consensus scenario is that ultra-faint, low-mass galaxies contributed most to the UV background at high-redshift and that reionization was an inhomogeneous process, with ionized bubbles created first around galaxy overdensities. The very surprising discovery of Ly-alpha emission lines around a large fraction of the most luminous galaxies at z=7.4-8.7, when we expect the universe to be highly neutral, could thus be explained by the fact that they lie in large HII bubbles which were ionized thanks to yet undetected fainter neighbors. Theoretical models indeed predict a boost of up to 6x larger galaxy counts around the brightest sources compared to the general field, when probing down to luminosities as faint as 0.1L_{UV} of the central source. Here we propose a direct test of these models by searching for fainter neighbors around three bright z>7.4 galaxies emitting Ly-alpha, including two sources that lie only 9 Mpc from each other and could share the same ionized bubble, as well as the most distant confirmed Ly-alpha emitter EGSY-8p7 at z=8.68. Given the expected overdensities, we have the opportunity to detect 20 (and up to 50) new z~7-9 galaxies with only a modest investment of HST time. These observations are thus maximally efficient at providing a large number of precious high-redshift targets for early JWST spectroscopy to directly study the galaxies that are in the process of ionizing the universe. Our imaging will further enhance the legacy of the CANDELS/EGS field, and we will make the reduced data available to the community immediately for JWST follow-up.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15335
Program Title: What is the metallicity of the cool ISM in our own Galaxy?

Principal Investigator: Annalisa De Cia
PI Institution: European Southern Observatory - Germany

The Interstellar Medium (ISM) has a fundamental role for star and planet formation, and the exchange of metals within the baryon cycle. Remarkably, the cool ISM metallicity in our own Galaxy is not known to date, and it is typically assumed to be solar. ISM abundances can and have been measured with UV spectroscopy, but are heavily affected by the presence of dust. Refractory metals are missing from the gas-phase because they are locked into dust grains (dust depletion). The degeneracy between metallicity and dust depletion limited past studies to assume solar metallicity for the Galactic ISM, and assign any deviation from it to dust depletion. In De Cia et al. 2016 we have developed a method to characterize dust depletion without assumptions on the metallicity. We can now measure the dust-corrected metallicity in the ISM, as long as H, Zn, Fe, and a third metal are constrained, which we collected for only 12 lines of sight so far. We propose to expand and improve this sample of ISM metallicities by observing 25 hot stars (with known H and at different Galactic latitudes and E(B-V)) deploying a STIS NUV echelle setting that will allow us to constrain Zn, Fe, and Cr abundances along these lines of sight. We will learn 1) whether the cool ISM metallicity toward a total of 37 lines of sight is really solar, or deviates from it; 2) whether there are radial gradients of metallicity in the Galaxy ISM; and 3) whether lines of sight with higher dust content have also higher metallicity.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15230
Program Title: Inner stellar halos of spiral galaxies: accretion or in-situ formation?

Principal Investigator: Roelof de Jong

PL Institution: Leibniz-Institut fur Astrophysik Potsdam (AIP)

The stellar halos surrounding spiral galaxies like the Milky Way are thought to be old and metal-poor. Indeed, we see little evidence for recent star formation in the form of main sequence stars or He burning stars in the color-magnitude diagrams (CMDs) of the stellar halos of the 16 nearby disk galaxies in our GHOSTS HST survey. It is therefore surprising, that we do see bright Asymptotic Giant Branch (AGB) stars in our CMDs, stars that are typically between 0.5 and 2.5 Gyr old. Recent simulations show two viable models for the origin of these intermediate age halo stars: 1) they have been brought in by gas-rich, star-forming, recently-disrupted satellites or 2) they have been dislodged from the main galaxy disk by recent interactions.

To constrain their origin, we propose to use WFC3 F673N narrowband imaging on two stellar halos to determine the fraction of carbon (C) stars in the detected AGB population. Classical carbon stars only form effectively at lower metallicities ([Fe/H]<-0.3) and hence will be low in number compared to normal (M-type) AGB stars if this mysterious AGB population originates from the main disk, but the C star fraction will be high if they originate from accreted metal-poor dwarf galaxies. Such measurements are hard to do in the Milky Way and M31, and NGC253 is the only disk galaxy where this halo C star fraction has been mapped before. We will triple this sample by measuring M-to-C fractions at distances 15-30kpc above the midplane of NGC891 and NGC4565. The relative distributions of C stars, M-giants and RGB stars will be compared to our suite of halo formation models to determine the relative importance of accretion vs. in situ formation.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category:  GO  
Scientific Category:  Solar System  
ID:  15130  
Program Title:  Giant impacts on giant planets  

Principal Investigator:  Imke de Pater  
PI Institution:  University of California - Berkeley

The 2009 impact and recent superbolides on Jupiter caught the world by surprise and cast doubt on impactor flux estimates for the outer solar system. Enhanced amateur planetary imaging techniques yield both high spatial resolution (enabling the 2009 impact debris field detection) and rapid frame rates (enabling the 2010/2012 impact flash detections and lightcurve measurements).

We propose a ToO program to image future impacts on Jupiter and Saturn. To remove the possibility of impact cloud non-detections, the program will be triggered only if an existing impact debris field is seen, an object on a collision course with Jupiter or Saturn is discovered, or an impact light curve is measured with an estimated total energy large enough to generate an impact cloud in a giant planet atmosphere (10^19 J).

HST provides the only way to image these events in the ultraviolet, providing information on aerosol altitudes and on smaller particles that are less visible to ground-based infrared observations. High-resolution imaging with proper timing (not achievable from the ground) is required to measure precisely both the velocity fields of impact sites and the optical spectrum of impact debris. HST observations of past impacts on Jupiter have also served both as cornerstones of science investigations at other wavelengths and as vehicles for effective public outreach.

Large outer solar system impacts are governed by the same physics as in the terrestrial events that dominate the impact threat to humans. Studying the behavior of impactors of various sizes and compositions, as they
Proposal Category: GO
Scientific Category: Planets and Planet Formation
ID: 15304
Program Title: Collecting the Puzzle Pieces: Completing HST's UV+NIR Survey of the TRAPPIST-1 System ahead of JWST

Principal Investigator: Julien de Wit

PI Institution: Massachusetts Institute of Technology

Using the Spitzer Space Telescope, our team has discovered 7 Earth-sized planets around the nearby Ultra-cool dwarf star TRAPPIST-1. These planets are the first to be simultaneously Earth-sized, temperate, and amenable for in-depth atmospheric studies with space-based observatories (notably, JWST). TRAPPIST-1's system thus provides us with the first opportunity to probe the atmospheres of Earth-sized exoplanets and search for signs of habitability beyond our solar system, which will require spectral information from the UV to the IR to complete their atmospheric puzzles.

We request 114 HST orbits to complete the UV+NIR survey of the 7 planets in preparation for their in-depth followup with JWST. The suggested low-density of the planets combined with their complex orbital resonance chain indicate that they migrated inward to their current positions and may harbor large water rich reservoir or leftover primordial H2 atmospheres. We have already ruled out the presence of clear H2 atmospheres for the 5 innermost planets using WFC3 and are requesting 16 WFC3 orbits to complete the TRAPPIST-1 NIR reconnaissance survey. Our primary request consists in 98 STIS orbits to complete the survey for extended H-exospheres around each of the planets. H-exospheres are the most accessible observables for volatile reservoirs, which have not been ruled out by our WFC3 observations. Exosphere detection is only amenable using HST unique capabilities in the UV and are pivotal to guide JWST’s in-depth followup. The combined information from HST's UV and NIR observations will allow us put the first critical pieces of the atmospheric puzzle in place for these temperate earth-sized worlds.
Proposal Category: GO
Scientific Category: Planets and Planet Formation
ID: 15131
Program Title: The first near-infrared reflectance spectrum of an exoplanet

Principal Investigator: Jean-Michel Desert
PI Institution: Universiteit van Amsterdam

Amongst the important results that came out in the field of exoplanetology is that clouds and hazes in exoplanet atmospheres seem to be ubiquitous. Their presence provides important information on the chemistry and composition of atmospheres, and have major impact on planets' energy budgets and evolutions. Aerosols are also important observationally because they prevent probing deeper atmospheric composition, and they have been the common interpretation in a long list of published featureless transmission spectra. However, none of these indirect detections can definitely confirm or deny the presence of aerosols; thus, we propose a program that will change our view on aerosols by looking at their reflectivity.

Theoretical models and laboratory experiments have long speculated on the origins and properties of aerosols in exoplanet atmospheres. More recent studies have shown that photochemical hazes can be very reflective in the near-Infrared (NIR) for planets cooler than 900 K. We propose to tackle this revolutionizing idea by pioneering an observational program that will both test these new models and provide a novel way to study atmospheres of exoplanets.

We will look for reflective hazes in the NIR with WFC3 and deliver the first geometric albedo spectrum (Ag) of an exoplanet: WASP-80b. We will measure expected reflectivity (Ag=0.5) at high level of confidence (7-Sigma), and put stringent limits on haze models. This program will provide a pathway towards the study of exoplanets around low mass-stars through their reflectivity, which is urgent since these will be the golden targets for JWST. Only HST can provide the required precision for such an experiment.
Proposal Category: AR
Scientific Category: Cosmology
ID: 15015
Program Title: Constraining the evolution of the Hubble Parameter using cosmic chronometers

Principal Investigator: Hugh Dickinson
PI Institution: University of Minnesota - Twin Cities

Substantial investment is being made in space- and ground-based missions with the goal of revealing the nature of the observed cosmic acceleration. This is one of the most important unsolved problems in cosmology today.

We propose here to constrain the evolution of the Hubble parameter \([H(z)]\) between \(1.3 < z < 2\), using the cosmic chronometer method, based on differential age measurements for passively evolving galaxies. Existing WFC3-IR G102 and G141 grisms data obtained by the WISP, 3D-HST+AGHAST, FIGS, and CLEAR surveys will yield a sample of \(\sim 140\) suitable standard clocks, expanding existing samples by a factor of five. These additional data will enable us to improve existing constraints on the evolution of \(H\) at high redshift, and insodoing to better understand the fundamental nature of dark energy.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions) 

Proposal Category: GO  
Scientific Category: Stellar Physics  
ID: 15104  
Program Title: Probing CO-dark Gas within the Planck Galactic Cold Clumps

Principal Investigator: Cody Dirks  
PI Institution: Northwestern University

The Planck Catalogue of Galactic Cold Clumps (PGCC) has identified the coldest regions of interstellar dust across the entire sky based on submillimeter emission. These sources range from relatively diffuse cold clouds to pre-stellar cores embedded in giant molecular clouds. In recent years, theoretical and observational evidence has shown that there exists a component of the cold molecular ISM that is "CO-dark" - that is, it contains very little carbon monoxide, the most common tracer of molecular hydrogen, and thus is hidden and unaccounted for in our measurements of the molecular content of the ISM. The PGCC represents an excellent test bed to probe for this CO-dark gas. To do so, we can use the high-resolution UV absorption line capabilities of the STIS instrument to probe for CO at higher sensitivities than CO emission line surveys. Furthermore, we can independently measure both the molecular hydrogen and total hydrogen content, which have been shown to correlate well with CI and O I absorption, respectively. As part of a previous archival survey, we identified existing STIS sightlines in the sky vicinity of PGCC objects, and found that a surprisingly small number of these sightlines displayed strong CO absorption. This general lack of CO absorption directly indicates the presence of CO-dark gas near these cold dust emission sources. However, our archival study found no high-resolution far-UV STIS spectra of any stars that lie directly behind a PGCC source. We now propose to observe seven sightlines that probe the central cores of these regions, allowing us to better characterize the prevalence and nature of CO-dark gas in these sources.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Stellar Populations
ID: 15199
Program Title: Building an astrometric reference frame for tests of General Relativity with stellar orbits at the Galactic center with HST and GAIA

Principal Investigator: Tuan Do
Pl Institution: University of California - Los Angeles

The short-period star S0-2 will reach its closest approach to the supermassive black hole at the Galactic center in 2018 at a separation of < 120 AU. This event will offer the first of a series of tests of General Relativity with stellar orbits around a supermassive black hole, an unexplored regime for tests of gravity. While S0-2 has been monitored for over 20 years with high angular resolution measurements from the ground, the astrometric reference frame is currently not stable enough for GR tests. The current reference frame is constructed using observations of 7 radio masers with narrow-field adaptive optics imaging from the ground. While this method provides a reference frame that is stable enough to measure the Keplerian orbits, it does not meet the more stringent requirements needed to measure post-Newtonian effects such as the precession of the periapse of the orbit. The small number of reference stars and the systematic errors associated with using large mosaics to observe these stars limit the accuracy of this method. We propose to construct a new reference frame for tests of gravity with WFC3-IR observations in Cycles 25, 26, & 27. When combined with absolute positions and proper motions from GAIA, these observations will provide the required precision in the reference frame. The WFC3-IR field of view has over 1000 times greater areal coverage than the narrow-field AO observations, providing 3 times the number of absolute reference sources from GAIA. The proposed observations build on a legacy of HST, GAIA, and adaptive optics data to open an era of gravitational science with orbits at the Galactic center.
Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15164
Program Title: Ultraviolet spectroscopy of the dust extinction in the M31 inner bulge

Principal Investigator: Hui Dong
PI Institution: Instituto de Astrofisica de Andalucia (IAA)

The extinction curve in the central 250 pc region of the M31 bulge is substantially steeper than that in the Milky Way. In addition, there is also clear evidence for a strong 2175 Angstrom extinction bump, the strength of which shows variation among different dusty clumps in the region. To better understand these important characteristics of the extinction properties and their spatial variation, we propose to use the HST/STIS, the only long-slit ultraviolet spectroscopic detector available, to observe two prominent dusty clumps. Combining with the existing photometric data, we will contrast these dusty clumps with neighboring extinction-free regions to construct their extinction curves, which will allow us to precisely measure the slope in the UV wavelength range and to tightly quantify the width and strength of the 2175 Angstrom bump. The results compared with the existing multi-wavelength data will enable us to address such questions as: 1) What causes the steep slope of the extinction curve in the M31 bulge? 2) How does the variation of the extinction curve, especially the 2175 Angstrom bump, depend on the properties and environments of the clumps? The results of this investigation should have strong implications for the dust extinction corrections for stellar light from other similar galactic spheroids.
Proposition Category: GO
Scientific Category: Stellar Physics
ID: 15270
Program Title: The Coolest Sample of Brown Dwarf Dynamical Masses

Principal Investigator: Trent Dupuy

PI Institution: University of Texas at Austin

We propose a 3-year orbit monitoring program to measure the first dynamical masses for brown dwarfs below 1100 K. With projected separations of only 1-2 AU, our targets are among the tightest substellar visual binaries ever found and are amenable to orbit determinations within only a few years. When combined with our parallax determinations, these data will yield dynamical masses with <10% uncertainties. Our targets have been discovered at the limits of existing facilities and thus promise to be the only viable objects in this temperature regime (350-1000 K) for direct mass measurements during the JWST era.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: AR
Scientific Category: Stellar Populations
ID: 15016
Program Title: Calibrating the Near-Infrared Tip of the Red Giant Branch with Multiwavelength Photometry

Principal Investigator: Meredith Durbin
PI Institution: University of Washington

The near-infrared (NIR) tip of the red giant branch (TRGB) shows outstanding promise as a distance indicator. In the JWST era, the NIR-TRGB will bridge the gap from local geometric parallax (with Gaia) out to the low-velocity Hubble flow in a single step, in all types of galaxies. However, there currently exist several impediments to JWST’s using the TRGB to full advantage. Dalcanton et al. (2012) presented the most comprehensive dataset available for calibrating the TRGB absolute magnitude, with optical and NIR coverage of 23 nearby dwarf and spiral galaxies spanning a wide range of ages and metallicities. However, subtle offsets between this dataset, theoretical models, and globular clusters raise concerns about the calibration.

We propose to perform a complete re-reduction and re-analysis of this dataset. We have developed a pipeline that leverages simultaneous fitting of optical and NIR data to produce NIR photometry of higher quality and completeness, with up to 1.5 mag greater depth than can be achieved with the NIR alone. With this added depth, improvements in photometric precision, and updated WFC3/IR PSFs and flux calibration, we will derive uniform, precise, and accurate NIR TRGB measurements, with which we will be able to resolve standing issues with the TRGB color-absolute magnitude relation and its behavior with changing star-formation histories. This work will lay the groundwork for extending the TRGB distance scale out to at least 37 Mpc with JWST. We will release the resulting 4-filter optical-NIR photometry as HLSPs for use by the community before the launch of JWST, to serve as a resource for proposing for stellar population observations in the NIR.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: SNAP
Scientific Category: Cosmology
ID: 15132
Program Title: Beyond MACS: A Snapshot Survey of the Most Massive Clusters of Galaxies at z>0.5

Principal Investigator: Harald Ebeling
PI Institution: University of Hawaii

Truly massive galaxy clusters play a pivotal role for a wealth of extragalactic and cosmological research topics, and SNAPshot observations of these systems are ideally suited to identify the most promising cluster targets for further, in-depth study. The power of this approach was demonstrated by ACS/WFC3 SNAPshots of X-ray selected MACS and eMACS clusters at z>0.3 obtained by us in previous Cycles (44 of them in all of F606W, F814W, F110W, and F140W). Based on these data, the CLASH MCT program selected 16 out of 25 of their targets to be MACS clusters. Similarly, all but one of the six most powerful cluster lenses selected for in-depth study by the HST Frontier Fields initiative are MACS detections, and so are 16 of the 29 z>0.3 clusters targeted by the RELICS legacy program.

We propose to extend our spectacularly successful SNAPshot survey of the most X-ray luminous distant clusters to a redshift-mass regime that is poorly sampled by any other project. Targeting only extremely massive clusters at z>0.5 from the X-ray selected eMACS sample (median velocity dispersion: 1180 km/s), the proposed program will (a) identify the most powerful gravitational telescopes at yet higher redshift for the next generation of in-depth studies of the distant Universe with HST and JWST, (b) provide constraints on the mass distribution within these extreme systems, (c) help improve our understanding of the physical nature of galaxy-galaxy and galaxy-gas interactions in cluster cores, and (d) unveil Balmer Break Galaxies at z~2 and Lyman-break galaxies at z>6 as F814W dropouts.

Acknowledging the broad community interest in our sample we waive our data rights for these observations.
Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15305
Program Title: The Secret Lives of Cepheids: Completing the Picture with HST-COS Observations of the Nearest Classical Cepheids, Polaris and delta Cephei

Principal Investigator: Scott Engle
PI Institution: Villanova University

Classical Cepheids, although well studied in terms of their cosmologically important Period-Luminosity Law, are proving to be increasingly complex and astrophysically intriguing in terms of atmospheric energetics. This proposal expands on data collected by us in previous cycles to probe Cepheid atmospheres, understand their heating mechanisms and answer important questions. Our previous COS FUV spectra revealed a wealth of 10,000-300,000K plasma emission lines, phase-locked with each Cepheid’s pulsation periods, showing that a pulsation-driven heating mechanism is at work. To significantly expand the parameter space of the Cepheid sample, we propose four visits to the nearest and brightest Cepheid, Polaris. Only two COS spectra of Polaris were acquired previously. But we have now seen that Cepheids undergo fairly large FUV emission line variations (flux level differences of 20x and more). Observations of the ultra-low amplitude Polaris will offer remarkable insights into the effects that even minimal pulsations have on a cool supergiant atmosphere, especially when compared to full amplitude Cepheids and also non-pulsating supergiants in the instability strip. We have also recently proven that delta Cep is an X-ray variable, with a tight pulsation phase-range where the star’s X-ray activity increases by over 4x. However, no COS spectra exist at this phase, which will be necessary to determine atmospheric densities and dynamics during the X-ray enhancement. When combined with our existing X-ray and FUV data set, the proposed COS data will advance a much deeper understanding of Cepheids and their atmospheric plasmas.
Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15133
Program Title: Solving the Mystery of Galaxy Bulges and Bulge Substructure

Principal Investigator: Peter Erwin

PI Institution: Max-Planck-Institut fur extraterrestrische Physik

Understanding galaxy bulges is crucial for understanding galaxy evolution and the growth of supermassive black holes (SMBHs). Recent studies have shown that at least some -- perhaps most -- disk-galaxy bulges are actually composite structures, with both classical-bulge (spheroid) and pseudobulge (disky) components; this calls into question the standard practice of using simple, low-resolution bulge/disk decompositions to determine spheroid and SMBH mass functions. We propose WFC3 optical and near-IR imaging of a volume- and mass-limited sample of local disk galaxies to determine the full range of pure-classical, pure-pseudobulge, and composite-bulge frequencies and parameters, including stellar masses for classical bulges, disky pseudobulges, and boxy/peanut-shaped bulges. We will combine this with ground-based spectroscopy to determine the stellar-kinematic and population characteristics of the different substructures revealed by our WFC3 imaging. This will help resolve growing uncertainties about the status and nature of bulges and their relation to SMBH masses, and will provide an essential local-universe reference for understanding bulge (and SMBH) formation and evolution.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Stellar Physics  
ID: 15165  
Program Title: Connecting mass accretion and ejection in pre-main sequence stars

Principal Investigator: Catherine Espaillat  
PI Institution: Boston University

Many pre-main sequence stars are surrounded by circumstellar material and display the typical signatures of astrophysical accretion disks, namely mass accretion onto the central object and mass ejection via jets. There is an observed correlation between the accretion rate onto the star and the mass loss rate. This suggests a linked formation mechanism, presumably the stellar magnetic field which can both channel material onto the star as well as eject it in collimated jets along twisted field lines. This correlation is based on secondary tracers of the accretion rate and mass loss rate (e.g., emission lines). Here we propose a more direct test of the observed correlation between mass accretion and ejection by using UV emission to detect accreting gas and centimeter emission to trace the jet while disentangling the influence of high-energy X-ray radiation from the star. This would be the first simultaneous HST-Chandra-VLA observation of a young, accreting star.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Planets and Planet Formation  
ID: 15134  
Program Title: A global map of thermal inversions for an ultra-hot planet

Principal Investigator: Tom Evans  
PI Institution: University of Exeter

WASP-121b is one of the standout exoplanets available for atmospheric characterization, both in transmission and emission, due to its large radius (1.8 Rjup), high temperature (~2400K), and bright host star (H=9.4mag). Recent WFC3/G141 transit and eclipse observations of WASP-121b by our group show clear detections of water at 1.4 micron that are in absorption on the nightside and emission on the dayside, implying that the planet has a dayside thermal inversion. Combined, these factors make WASP-121b the best target available to observationally probe the variation of thermal inversions with longitude. Here we propose spectroscopic phase-curve measurements of WASP-121b over a full orbital period with WFC3/G141. Given the measurement precision demonstrated by our previous transit and eclipse observations with WFC3, we anticipate an unprecedented signal-to-noise for a near-infrared exoplanet phase curve. Combined with state-of-the-art atmospheric retrieval analysis and circulation models, our data will produce a longitudinally-resolved map of the atmospheric thermal structure, and will track the thermal inversion with longitude by measuring the 1.4 micron H2O feature as it transitions from absorption to emission. This information-rich dataset will provide valuable new insight into the long-standing mystery of thermal inversions in hot gas giants, which will provide critical constraints for the global circulation and the molecular sources that produce thermal inversions.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Planets and Planet Formation
ID: 15135
Program Title: An exoplanet with a stratosphere: seeking the unknown absorber

Principal Investigator: Tom Evans
PL Institution: University of Exeter

The extent to which significant stratospheres form in highly-irradiated gas giant exoplanets is still a major unresolved question in the field. Using WFC3 G141, we have recently measured a thermal emission spectrum for WASP-121b (T~2700K). The 1.4 micron water band is spectrally-resolved in emission, providing a clear detection of a thermal inversion in the atmosphere. From this measurement, we conclude that the most likely cause of the inversion is absorption of impinging stellar radiation by a high-altitude optical absorber, as other heating mechanisms are almost certainly insufficient. Intriguingly, the G141 spectrum also shows a flux excess at ~1.22 micron, which can be well-explained by vanadium oxide emission. Indeed, absorption by vanadium oxide and titanium oxide has been proposed as a possible means by which to generate stratospheres in the hottest exoplanets. However, we are currently unable to draw a confident conclusion on the presence of vanadium oxide in the atmosphere of WASP-121b with the available data. We propose here to rectify this situation, by extending the wavelength coverage of the measured thermal spectrum across the 0.9-1.1 micron wavelength range using WFC3 G102. This will allow us to target the prominent vanadium oxide and titanium oxide bands at these wavelengths, where the flux from the planet is still high. If observed, a long-theorized link would be established between these important chemical species and thermal inversions in highly-irradiated atmospheres.
Proposal Category:  AR
Scientific Category:  Galaxies and the IGM
ID:  15017
Program Title:  Models of Stellar Streams for Constraining Local Group Dynamics with HST Proper Motion Data

Principal Investigator:  Mark Fardal

PI Institution:  Space Telescope Science Institute

HST Proper Motion (PM) measurements over the past decade have revolutioned our understanding of Local Group Dynamics. This offers the opportunity to obtain crucial new constraints on the outer halo of the two main Local Group galaxies, the Milky Way and M31. These halos are crucial for understanding the growth of these galaxies, and the physics of the dwarf galaxy population around them. Yet their structures and gravitational potential are very poorly known. We propose to model recent HST PM data of the Sagittarius and Orphan stellar tidal streams with a new stream modeling framework, which uses a combination of particle spray models and N-body simulations in a Bayesian context. This work will measure the total masses of the MW and the LMC, and connect the orbits of the stream progenitors to their star formation and quenching. It will also provide a general software framework to the community for modeling other streams, and making detailed comparison to a range of observations with HST and other facilities.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Planets and Planet Formation  
ID: 15068  
Program Title: A Detailed Study of Rocky Planetary Material in the Hyades

Principal Investigator: Jay Farihi  
PI Institution: University College London

The Hyades is the nearest open cluster, relatively young, and containing numerous A-type stars. Its youth, distance, and metallicity make it an ideal site to study planet formation around 2-3 Msun stars, and in a dynamically challenging environment.

During our HST COS Snapshot, we discovered the ongoing accretion of Si-rich and C-deficient material in two white dwarf Hyads. The lower limit Si/C ratios determined from these 400s exposures indicate the material is more C-depleted than in chondritic meteorites, the most primitive rocks in the Solar System. Our 2013 Keck discovery of metal pollution in a third Hyades white dwarf indicates that planet formation is common in the cluster. Together, these three stars indicate that substantial minor bodies persist at several AU or more, and provide an unprecedented opportunity for a detailed study of rocky exoplanet precursors in a cluster environment.

We propose to obtain detailed abundances of the planetary debris at these three polluted Hyads, which requires a modest investment of observatory time. The mass ratios between C, O, Mg, and Si are accurate indicators of the temperature and orbital regions where the parent bodies formed, their water and volatile contents. We will also detect Al and Fe, which are key indicators of differentiation and giant impacts among planetary embryos.

Our proposed observations will provide legacy value for planet formation models, and especially those in...
Luminous starbursts, systems with SFRs exceeding $\sim$1000Msun yr$^{-1}$, are predicted to be extremely rare at $z>3$. However, recent observations find such systems at rates of tens to hundreds above predictions. This discrepancy is extremely difficult to explain. Case studies of such luminous starbursts are thus of profound importance to understand how star formation is triggered and quenched at $z > 3$, and help reconcile models with observations.

Our group has been intensively studying the quasar SDSS J160705.16, at $z = 3.65$ (or 1.7Gyr after the Big Bang). This quasar is an excellent case study of luminous star formation at $z > 3$, and how AGN activity may affect such star formation. SDSS J160705.16 harbors both a broad-line, luminous quasar and an extremely high star formation rate, with an AGN luminosity of $\sim$10$^{47}$ ergs s$^{-1}$ and an SFR of $\sim$2000 Msol yr$^{-1}$. Sub-mm interferometry has further revealed that the star formation is highly spatially extended on scales up to 40kpc. Furthermore, VLA observations show an emerging $\sim$4kpc radio jet.

We here propose WFC3 imaging with the following goals: (1) to set precise constraints on any lensing magnification, (2) to determine the morphology and color structure of the extended star formation, (3) to compare the optical morphology of the star formation to that seen in the sub-mm data, and (4) to search for evidence that SDSS J160705.16 resides in a protocluster.
Proposal Category: GO
Scientific Category: Stellar Populations
ID: 15336
Program Title: The Globular Cluster Systems of Local Group Dwarf Galaxies

Principal Investigator: Annette Ferguson
PI Institution: University of Edinburgh, Institute for Astronomy

We propose to obtain deep ACS and WFC3 imaging of 26 globular clusters (GCs) lying in three Local Group dwarf galaxies -- NGC 147, NGC 185 and NGC 6822. These three galaxies possess the richest dwarf galaxy GC systems known within the Local Group and our sample represents their entire GC populations. We will characterize, in unprecedented detail, the properties of the GCs in these low mass systems and construct a reference dataset against which to compare the properties of suspected accreted families of GCs in the M31 and Milky Way halos. Our deep imaging will allow us to derive the properties of the constituent stellar populations (e.g. metallicities, HB morphologies) of the GCs, as well as their structural parameters and line-of-sight distances, and quantify the variation within and between GC systems in galaxies of the dE and dIrr classes. In addition, our imaging will facilitate the construction of deep colour-magnitude diagrams for a wide swathe of the field populations in these dwarf galaxies, from which we will extract detailed star formation histories. This will enable us to analyse spatial variations in their stellar mass assembly histories (complementing previous deep single field studies of these systems) and quantitatively compare the history of star formation as traced by field stars and GCs.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15271
Program Title: Can Low-Luminosity Galaxies Reionize the Universe?

Principal Investigator: Harry Ferguson
PI Institution: Space Telescope Science Institute

The prevailing wisdom is that low-luminosity galaxies are responsible for cosmic reionization. If this is true, then low-luminosity galaxies at high redshift have to be different from most of the low-luminosity galaxies studied to date at low redshift, which absorb too much of their ionizing radiation. While it is possible that high-z dwarf galaxies have the same metallicity at fixed mass and star-formation rate as low-redshift galaxies, they are different in one key respect. At fixed dark-halo mass, they are probably much denser (having collapsed earlier). This could lead to higher star-formation surface densities more capable of creating cavities in the ISM. But the denser halos of surrounding gas could be harder to clear.

There is a critical need for further observations to validate and test physical models for the trends of escaping ionizing continuum with redshift, luminosity, and surface density. JWST will not be able to measure ionizing radiation during the epoch of reionization because the IGM absorbs most of the photons. To prepare for JWST, we need to use the ultraviolet capabilities of HST to measure diverse samples of galaxies at z<3, where we can see the photons and quantify the trends with other galaxy properties.

As a complement to other studies, we propose to constrain the Lyman-continuum emission from 8 relatively low-luminosity strongly-lensed galaxies at 1<z<3. Coupled with ongoing work at z ~ 0, this will allow us to test for redshift evolution in the physical observables that can be used to predict Lyman-continuum radiation.
Proposal Category: AR
Scientific Category: Massive Black Holes And Their Host Galaxies
ID: 15018
Program Title: Plasma simulations that meet the challenges of HST & JWST Active Nuclei & Starburst observations

Principal Investigator: Gary Ferland

PI Institution: University of Kentucky

Recent HST AGN monitoring programs, such as the STORM Campaign, have resulted in the definitive set of emission-line-continuum lag measurements. The goals are to measure the structure of the inner regions of an AGN, understand the physics driving the variability, and use this to place black hole mass determinations on an even firmer footing. Photoionization models make it possible to convert these observations into physical parameters such as cloud density or location. Here I propose to improve the treatment of emission from species like C IV, C III], Mg II, or Fe II in the spectral / plasma simulation code Cloudy. Like all plasma codes, Cloudy uses a modified two-level approximation to solve for the ionization of many-electron ions. I have participated in meetings on modeling Tokamak plasmas, which share many of the properties of the BLR of AGN and have the advantage of being a controlled laboratory environment. These discussions have led to the development of tests to show the density range over which the two-level approximation is valid. It fails at the densities where the strong UV lines form. I will use the atomic data available within the fusion modeling community, along with the methods they have developed, to improve Cloudy models so that they can better inform us of the message in the UV spectrum. The improvements will be part of future releases of Cloudy, which is openly available and updated on a regular basis.
Proposal Category: GO
Scientific Category: Stellar Populations
ID: 15231
Program Title: Searching for fossil fragments of the Galactic bulge formation process

Principal Investigator: Francesco Ferraro
PI Institution: Universita di Bologna

We have discovered that the stellar system Terzan5 (Ter5) in the Galactic bulge harbors stellar populations with very different IRON content (delta[Fe/H]~1 dex, Ferraro+09, Nature 462, 483) and AGES (12 Gyr and 4.5 Gyr for the sub-solar and super-solar metallicity populations, respectively, Ferraro+16, ApJ,828,75). This evidence demonstrates that Ter5 is not a globular cluster, and identifies it as (1) a site in the Galactic bulge where recent star formation occurred, and (2) the remnant of a massive system able to retain the iron-enriched gas ejected by violent supernova explosions. The striking chemical similarity between Ter5 and the bulge opens the fascinating possibility that we discovered the fossil remnant of a pristine massive structure that could have contributed to the Galactic bulge assembly.

Prompted by this finding, here we propose to secure deep HST optical observations for the bulge stellar system Liller1, that shows a similar complexity as Ter5, with evidence of two stellar populations with different iron content. The immediate goal is to properly explore the main sequence turnoff region of the system for unveiling possible splits due to stellar populations of different ages. As demonstrated by our experience with Ter5, the requested HST observations, in combination with the K-band diffraction limited images that we already secured with GeMS-Gemini, are essential to achieve this goal.

The project will allow us to establish if other fossil remnants of the bulge formation epoch do exist, thus probing that the merging of pre-evolved massive structures has been an important channel for the formation of the Galactic bulge.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Stellar Populations
ID: 15232
Program Title: Pushing ahead the frontier of the Globular Cluster dynamics: the 3D view of the velocity space

Principal Investigator: Francesco Ferraro
PI Institution: Universita di Bologna

Globular clusters (GCs) are the only astrophysical systems that, within a Hubble time, undergo nearly all the physical processes known in stellar dynamics. Although they have been studied since the very beginning of modern Astrophysics, little is known from observations about their kinematical richness, thus preventing a complete understanding of their current dynamical state, formation and evolutionary history. Here we propose to determine the internal proper motions of stars down to the sub giant branch for a representative sample of Galactic GCs for which we are measuring line-of-sight velocities from a multi-instrument spectroscopic campaign at the ESO Very Large Telescope. The project will provide the first catalog of 3D velocities of hundreds individual stars in the cluster centers, where the most interesting dynamical processes are expected to occur. Long lasting open issues such as the accurate shape of the velocity dispersion profiles, the existence of systemic rotation and orbital anisotropy (and thus the level of relaxation), and the controversial presence of intermediate mass black holes in star clusters will be finally addressed. This will motivate the development of a new generation of fully constrained dynamical models able to properly describe the structural and dynamical properties of stellar systems and reconstruct the evolutionary paths that led to their current status.
Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15337
Program Title: An HST Survey of Cassiopeia A's Reverse Shock, High-Velocity Ejecta, and Shocked Clouds of Pre-SN Mass Loss

Principal Investigator: Robert Fesen

PI Institution: Dartmouth College

The young Galactic supernova remnant Cassiopeia A (Cas A) provides us with the clearest look at the properties and explosion dynamics of a high mass, core-collapse supernova (CCSN). With an explosion date around 1670, Cas A is the youngest Galactic core-collapse SNR known and, at an estimated distance of 3.4 kpc, it is also among the closest. Cas A's main shell ejecta knots are typically 0.1 - 0.5 arcsec in size and can show emission and morphological changes on timescales of just a few months. No other remnant, with the exception of SN 1987A, shows such rapid optical changes across large portions of its structure.

Here we propose a new, complete optical survey of Cas A, the first since 2004, in order to measure the velocity and asymmetry of Cas A's reverse shock front across the whole remnant and map the distribution of its high-velocity outer ejecta, particularly in regions which align to the motion of the central compact source. Halpha images of the remnant's shocked CSM clumps will also provide strong tests of shock-cloud models across a broad range of cloud densities and sizes. These data will constitute a rich and unique archive both for Cas A and the general study of high mass CCSNe.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category:  SNAP  
Scientific Category:  Stellar Physics  
ID:  15166  
Program Title:  Continuing a Snapshot Survey of the Sites of Recent, Nearby Supernovae: Cycles 25 & 26  
Principal Investigator:  Alex Filippenko  
PI Institution:  University of California - Berkeley

During the past two decades, robotic (or highly automated) searches for supernovae (SNe), including our Lick Observatory Supernova Search (LOSS), have found over 1000 SNe, many of them in quite nearby galaxies (cz < 4000 km/s). Most of the objects were discovered before maximum brightness, and have follow-up photometry and spectroscopy; they include some of the best-studied SNe to date. We propose to continue our successful program of imaging the sites of some of these nearby objects, to obtain late-time photometry that will help reveal the origin of their lingering energy. We will also search for possible stellar remnants of Type Iax SNe, an intriguing new possibility. Moreover, the images will provide high-resolution information on the local environments of SNe that are far superior to what we can procure from the ground. For example, we will obtain color-magnitude diagrams of stars in these SN sites, to constrain the reddening and SN progenitor masses. We will search for light echoes around SNe, an important clue to their progenitor systems. We also propose to image some "SN impostors" -- faint SNe IIn with massive progenitors -- to verify whether they are indeed superoutbursts of luminous blue variables and survived the explosions, or a new/weak class of massive-star explosions. Our proposed snapshots in Cycles 25 and 26 will complement and extend the set of targets we imaged in previous Cycles under this program.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: AR  
Scientific Category: Massive Black Holes And Their Host Galaxies  
ID: 15019  
Program Title: Do AGN Outflows Support Negative Feedback?

Principal Investigator: Travis Fischer  
PI Institution: NASA Goddard Space Flight Center

Radiation, winds, and jets of Active Galactic Nuclei (AGN) have been shown to interact with their host galaxy interstellar medium. This radiative or quasar mode of feedback is thought to play a large role in terminating star formation in the galaxy and the accretion of matter onto the central supermassive black hole, accounting for the observed correlation between central black hole and host bulge mass. Recent IFU observations of the nearby Seyfert 2 AGN Mrk 573 have shown that gas radiatively driven by the central engine only travels to radii of approximately 750pc, much smaller than what would be required to evacuate gas from the host bulge. Using archival HST imaging and spectroscopy, we propose to perform similar kinematic analyses on a sample of 23 additional, nearby Seyfert AGN. By generating radiative driving models and comparing them to the observed ionized-gas kinematics in each target, we will determine the maximum outflow radii of the ionized gas and whether these outflows are of scales that would be required in successful negative feedback scenarios.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Galaxies and the IGM  
ID: 15069  
Program Title: The ages and baryonic masses of clumps in turbulent, clumpy disk galaxies

Principal Investigator: David Fisher  
PI Institution: Swinburne University of Technology

We propose to measure the stellar populations and masses of massive star forming clumps at the resolution of the Jeans' length in a sample of massive, turbulent disk galaxies. Massive star-forming clumps are a critical component of the morphological transformation of galaxies and the build-up of bulges. If, however, clumps dissipate quickly bulges may not form through clump phase, then clumps would build thick disks. Different feedback prescriptions have drastically different effects on clumps. Some feedback models (e.g. Hopkins et al 2012, FIRE simulations) completely destroy clumps whereas other feedback models allow clumps to persist (e.g. Bournaud et al. 2014). Therefore, to build accurate models of galaxy evolution we must know how long the lives of clumps are. The problem is that both due to resolution and available wavelength coverage it is impossible to precisely measure the ages and stellar masses of individual clumps in high-z galaxies. We have discovered a sample of extremely rare galaxies at z~0.1 that are extremely gas rich, turbulent and have a clumpy distribution of ionized gas. In all ways they are identical to those of the high-redshift Universe. We propose to employ UV-optical-near IR imaging with WFC3 to measure the stellar masses and mean ages of a set of 6 clumpy galaxies, containing ~80 giant star forming clumps. This data complements our ALMA CO(1-0) maps of the same targets, and we will thus make the first maps of the full baryonic mass in turbulent disk galaxies. This work builds on our previous HST Halpha imaging program, and validates massive investments of HST time on high-z surveys of galaxies.
Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15272
Program Title: The Progenitor of Supernova 2016gkg

Principal Investigator: Gaston Flocelldi
PI Institution: Universidad Nacional de La Plata (UNLP)

 Supernova (SN) 2016gkg is called to be one of the most interesting events of its kind in the coming years. Its discovery minutes/hours after explosion, subsequent intensive monitoring from ground and space, and the existence of pre-explosion HST imaging where a progenitor candidate was detected, makes this SN an ideal case to study the fate of massive stars that explode after losing most of their outer envelopes. We propose to revisit the SN site with HST once the ejecta fade below the pre-explosion brightness in order to test the progenitor identification. This will also allow a better characterization of the progenitor object, which is crucial to confirm our proposal that it belonged to an interacting binary system.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Stellar Physics  
ID: 15306  
Program Title: Ultra-Rapid UV Spectroscopy of an Interacting Supernova Discovered by K2

Principal Investigator: Ryan Foley  
PI Institution: University of California - Santa Cruz

The supernova (SN) community is preparing for an extraordinary experiment. For 5 months, the Kepler telescope (K2) will perform a SN survey. Monitoring ~20,000 galaxies with a 30-minute cadence, K2 will detect ~50 SNe within hours - perhaps even minutes - of explosion. Such data have proven to be a unique window to the details of the SN explosion, progenitor, and circumstellar (CS) environment. We are devoting significant ground-based telescopic resources to search for and follow these SNe.

We propose to take advantage of these emergent SNe and exquisite K2 light curves to study 1 SN in detail with HST. For the first few days after a SN explosion, one can potentially see signs of the SN interacting with its CS environment (e.g., a wind, accretion disk, companion star) that are not present later in its evolution. For instance, the large UV flux from a SN shock breakout will ionize CS gas. As the gas recombines over the following days, it produces excess broad-band flux and reveals the CSM (and thus progenitor) composition through emission lines. While early optical data can be illuminating, its utility is limited. However, UV spectra can greatly enhance our understanding of SN progenitor systems, including progenitor composition, CS environment, and the existence of a binary companion. Our program will observe a single K2 SN that shows signs of early interaction.

Because of the ephemeral nature of the interaction signatures, this program requires an ultra-rapid ToO. The combination of K2 photometry, ground-based data, and HST UV spectra will be a completely unique and defining data set. As Kepler will soon be retired, this is our only opportunity for such a program.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15201
Program Title: Looking for the Coldest Atmospheres: a Search for Planetary Mass Companions around T and Y Brown Dwarfs

Principal Investigator: Clemence Fontanive
PI Institution: Royal Observatory Edinburgh

We propose to obtain WFC3/IR imaging of the very coolest brown dwarfs (T < 800 K) to search for substellar and planetary-mass companions to these objects. Companions discovered by this program would likely be analogues of the ~250 K brown dwarf WISE 0855 and would provide vital benchmark objects for theoretical model, closing the gap in mass and temperature between brown dwarfs and planets. Finding such an object as a member of a binary system would be even more valuable as it would allow for the measurement of dynamical masses. We recently placed the first constraints to date on the binary frequency for brown dwarfs with spectral types >T8. This program will triple our current sample size, a requirement in order to confirm our current results and compare substellar binary properties for various spectral type and age populations. The WFC3/IR plate will allow us to probe near equal-mass binaries down to separations of 0.2" (2-3 AU for the typical distances of our targets). True cool companions should show strong absorption around 1.4 um as a result of the deep water absorption band observed at that wavelength in substellar spectra. We therefore propose observations in the WFC3 F127M and F139M filters which will allow us to robustly identify bonafide candidates and distinguish them from background stars based on this spectral feature. Most of our targets lack suitable NGS AO guide stars or LGS AO tip-tilt stars to be observed with ground-based telescopes, and the 1.4 um water band is often unobservable from the ground due to telluric water absorption. WFC3 on HST is thus the only instrument suitable for these observations.
Proposal Category: GO
Scientific Category: Planets and Planet Formation
ID: 15338
Program Title: NUV Transit Spectroscopy of HD189733b: Measuring the Mass-loss and Ionization State of a Prototypical Escaping Atmosphere

Principal Investigator: Luca Fossati

PI Institution: Space Research Institute, Austrian Academy of Sciences

The benchmark hot Jupiters HD209458b and HD189733b have provided the foundations of comparative planetology for giant exoplanets, making them of paramount importance for atmospheric studies of short-period planets. HD189733b is the closest transiting hot Jupiter to Earth and transit observations have been obtained and studied across the electromagnetic spectrum, with the surprising exception of the near-ultraviolet: a unique window for atmospheric mass-loss studies owing to the strong resonance lines and large photospheric flux in this band. In order to make a quantitative assessment of the metallicity, ionization state, and outflow rate of this important system, and to complete the panchromatic archive of transit spectroscopy of this archetypal object, we request 15 HST orbits to obtain three STIS near-ultraviolet transit light curves of HD189733b. These observations will allow us to study the physical properties of the planet's upper atmosphere, constrain the composition of the haze layer characterising the optical transmission spectrum, and provide a reference spectrum for NASA's recently funded Colorado Ultraviolet Transit Experiment (CUTE) exoplanet mission, which will carry out a 1-year science mission to observe multiple near-ultraviolet transits of the brightest and most nearby short-period transiting planets to study the physics of atmospheric escape.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: AR
Scientific Category: Galaxies and the IGM
ID: 15020
Program Title: The Mass Outflow Rate of the Milky Way

Principal Investigator: Andrew Fox
PI Institution: Space Telescope Science Institute - ESA

The balance between gaseous inflow and outflow regulates star formation in spiral galaxies. This paradigm can be tested in the Milky Way, but whereas the star formation rate and inflow rate have both been measured, the outflow rate has not. We propose an archival COS program to determine the Galactic outflow rate in cool gas (~10^4 K) by surveying UV absorption line high-velocity clouds (HVCs). This project will make use of the newly updated Hubble Spectroscopic Legacy Archive, which contains a uniformly reduced sample of 233 COS G130M spectra of background AGN. The outflow rate will be determined by (1) searching for redshifted HVCs; (2) modeling the clouds with photoionization simulations to determine their masses and physical properties; (3) combining the cloud masses with their velocities and distances. We will measure how the outflow is distributed spatially across the sky, calculate its mass loading factor, and compare the line profiles to synthetic spectra extracted from new hydrodynamic simulations. The distribution of HVC velocities will inform us what fraction of the outflowing clouds will escape the halo and what fraction will circulate back to the disk, to better understand how and where gas enters and exits the Milky Way.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15339
Program Title: Properties of the Galactic Nuclear Wind at Low Latitudes

Principal Investigator: Andrew Fox
PI Institution: Space Telescope Science Institute - ESA

A biconical nuclear wind drives gas out from the center of the Milky Way, replenishing the giant Fermi Bubbles with new material. We have been using HST/COS to characterize the properties of the cool gas in the nuclear wind via UV spectroscopy of background AGN. Until now, only one low-latitude (|b|<30 degrees) UV-bright AGN was known, hampering our understanding of the mechanism driving the outflow. Thanks to the new UV-bright Quasar Survey (UVQS), we have identified five new confirmed low-latitude AGN, all in the poorly explored southern Fermi Bubble. These low-latitude directions are ideal for studying the nuclear outflow since they probe its base, where the wind is launched, and where the X-ray, gamma-ray, and UV signatures of the outflow are strongest. We request COS/FUV spectroscopic observations of these five QSOs to probe the outflow with a range of low-ionization and high-ionization metal-line tracers. With these data we will assess the kinematics and ionization level of the southern outflow, and determine its gas mass, mass flow rate, patchiness, and symmetry with respect to the northern outflow.
Proposal Category: GO
Scientific Category: Planets and Planet Formation
ID: 15070
Program Title: An HST Spectroscopic Study of Protoplanetary Disk Abundances: CO/H2 Conversion Factors and Absolute Abundances for JWST

Principal Investigator: Kevin France
PI Institution: University of Colorado at Boulder

Measurements of the masses and physical state of protoplanetary gas disks form the basis for estimating the initial conditions of planet formation. Among the most important constraints derived from disk diagnostics are the abundances and the physical conditions of the most important gas-phase species. Towards this end, we propose to measure absolute molecular abundances of H2, CO, H2O, and OH with HST-COS and STIS to characterize disk composition, molecular excitation temperatures, and spatial (velocity) stratification within the disk environment. These measurements will constrain the CO-to-H2 conversion factor in disks and place upcoming measurements of water and organic molecules with JWST onto an absolute abundance scale. We will achieve this goal by performing three central tasks:

(1) Measure the absorption spectra of primary molecular disk species (H2, CO, H2O, and OH) along the line-of-sight to the central star to obtain a one-dimensional slice through the disk

(2) Use these spectra to measure the column density, excitation temperature, and radial velocity of these species to determine the spatial stratification (or co-spatiality) of the gas parcels

(3) Use this information to characterize the absolute abundances (that is, relative to the H2 column density) of these major molecular species to determine the CO/H2 conversion factor and prepare for upcoming JWST disk observations. We will then characterize the abundance patterns as a function of evolutionary state of the disk and the strength of the local ultraviolet, photodissociating radiation field.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Stellar Physics  
ID: 15256  
Program Title: Imaging the transition of SN 1987A to SNR 1987A

Principal Investigator: Claes Fransson  
PI Institution: Stockholm University

SN 1987A is the great supernova (SN) of the HST era. An unbroken string of observations is the essential tool for detecting change and establishing a uniform legacy archive. Previous imaging has shown that the SN ejecta has changed from being powered by radioactive 44Ti up to day 5000, to being powered by the X-rays from the ring collision. This is seen both in the light curve and the rapidly changing morphology of the ejecta. As the X-rays penetrate further in we expect the metal rich core to also become illuminated. As the ejecta expand the dust in the center may become transparent and our limits on a compact object will become stronger, or yield a detection. Also the circumstellar ring surrounding the SN is undergoing a dramatic change. After a rapid increase, the flux reached a maximum around day 8000 and is now decaying rapidly. This marks the final destruction of the ring and we estimate that by 2025 it will be dissolved. At the same time, diffuse emission and new hot spots outside the inner ring are becoming visible, providing a tool to study the unknown circumstellar environment outside the ring.

Imaging in both narrow and broad bands allow us to follow these developments. The HST observations have a unique blend of photometric fidelity and angular resolution that makes them the indispensable partner to ongoing ground-based, X-ray and sub-mm ALMA observations, providing the morphology of both the inner metal rich core and the H-rich envelope. They will also be a necessary complement to our approved STIS and COS observations and by 2019 also of the JWST GTO observations. This is a long term study: given the rapid change we see, sampling every year is necessary.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Solar System  
ID: 15167  
Program Title: Unmasking the Dark Side of Iapetus

Principal Investigator: Richard French  
PI Institution: Wellesley College

We propose to take advantage of the unique capabilities of STIS in a UV-intensive series of observations to obtain high-SNR spectra of the bright and dark hemispheres of Iapetus over a critical near-UV range where Cassini instruments lack coverage (190-350 nm). The leading face of Iapetus acts a sort of canvas, painted with material from Saturn's captured moon Phoebe, itself an interloper from the Kuiper Belt, that may provide important clues to its composition and processing history of primordial material from the early stages of planet formation. This underscores the long-recognized importance of identifying the composition of the dark material on Iapetus and placing it in the context of other primitive Solar System objects. In spite of extensive Cassini observations, this has proven to be an elusive goal because of the lack of unique spectral signatures of possible dark materials in the wavelengths observed by Cassini. Each proposed darkening agent (nanoiron/hematite, aromatic and aliphatic tholins, NH3) has a distinctive signature within this previously unobserved spectral window. STIS observations will provide a critical test of proposed compositions for the dark material and its origin. We will draw on our team's extensive experience with STIS observations, Cassini UVIS and VIMS spectra, Earth-based near-IR spectroscopy, and radiative transfer scattering models to compare the observed spectra with predictions for a variety of candidate materials. The Iapetus results will complement recent STIS observations of other icy Saturn satellites (Program 13694 Hendrix) and the STIS-based investigation of the mysterious redness of Saturn's rings (Program 12478 Cuzzi).
Proposal Category: GO
Scientific Category: Planets and Planet Formation
ID: 15071
Program Title: The Mega-MUSCLES Treasury Survey: Measurements of the Ultraviolet Spectral Characteristics of Low-mass Exoplanetary Systems
Principal Investigator: Cynthia Froning
PI Institution: University of Texas at Austin

JWST will be able to observe the atmospheres of rocky planets transiting nearby M dwarfs. A few such planets are already known (around GJ1132, Proxima Cen, and Trappist-1) and TESS is predicted to find many more, including ~14 habitable zone planets. To interpret observations of these exoplanets' atmospheres, we must understand the high-energy SED of their host stars: X-ray/EUV irradiation can erode a planet's gaseous envelope and FUV/NUV-driven photochemistry shapes an atmosphere's molecular abundances, including potential biomarkers like O2, O3, and CH4. Our MUSCLES Treasury Survey (Cycles 19+22) used Hubble/COS +STIS UV observations with contemporaneous X-ray and ground-based data to construct complete SEDs for 11 low-mass exoplanet hosts. MUSCLES is the most widely used database for early-M and K dwarf (>0.3 M_sun) irradiance spectra and has supported a wide range of atmospheric stability and biomarker modeling work. However, TESS will find most of its habitable planets transiting stars less massive than this, and these will be the planets to characterize with JWST. Here, we propose to expand the MUSCLES project to: (a) new M dwarf exoplanet hosts with varying properties; (b) reference M dwarfs below 0.3 solar masses that may be used as proxies for M dwarf planet hosts discovered after HST's lifetime; and (c) more rapidly rotating stars of GJ1132's mass to probe XUV evolution over gigayear timescales. We propose to gather the first panchromatic SEDs of rocky planet hosts GJ1132 and Trappist-1. This proposal extends proven methods to a key new sample of stars, upon which critically depends the long-term goal of studying habitable planet atmospheres with JWST and beyond.
ASASSN-15lh is the most luminous optical transient ever detected. Yet its nature is unclear. It was first thought to be a supernova. However, its host shows little sign of star formation, and the transient has remained extremely hot for nearly two years, making a supernova origin seem less likely. Alternatively, ASSASN-15lh may be a flare caused by the tidal disruption of a star that has flown too close to a supermassive black hole. However, this model is also far from an easy fit. The luminosity of the host's bulge implies a black hole mass so large that a star would almost certainly be swallowed before disrupted, unless the the black hole is spinning relativisitically. Furthermore, the double-humped shape of the light curve seen in the UV is highly unusual for a tidal disrution flare (TDF). Here we propose observations using nearly the entire wavelength range of HST to elucidate the nature of this object. We will be able to determine the location of the transient with respect to the host bulge light, and thus the likely position of the black hole, to ~20 pc, or nearly an order of magnitude better than the present best estimate. We will measure the temperature of the transient, which may prove too high for a supernova at such a late time, and study the host star-formation, which is essential for producing a supernova. Additionally, we will attempt to confirm (or refute) the apparent evidence for a recent merger we have found in the extant HST images. A merger should greatly enance the rate of stellar disruptions by a central black hole. Together these obsevations will dramatically improve our entendring of this most extraordinary transient.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category:  AR
Scientific Category:  Stellar Physics
ID:  15021
Program Title:  Pre-supernova properties of progenitors detected by HST

Principal Investigator:  Jim Fuller
PI Institution:  California Institute of Technology

HST has provided essential data on the connection between core-collapse supernovae (SNe) and their massive star progenitors, both through precise post-explosion localization of nearby SNe, and by identification of progenitor stars in pre-explosion HST images. However, mounting evidence suggests that many SN progenitors exhibit outbursts and/or enhanced mass loss in the years preceding the SN, potentially affecting the progenitor properties measured by HST. Inferring progenitor characteristics such as stellar mass thus requires a better theoretical understanding of the pre-SN stellar evolution. A compelling mechanism for pre-SN outbursts is energy transport via gravity/acoustic waves within massive star SN progenitors. We propose to quantify the observable effects of wave-driven outbursts and mass loss in the final years of massive star lives using stellar evolution calculations incorporating wave energy transport. Our models will make predictions for progenitor luminosity in HST bands as a function of stellar mass and time before SN explosion. We will also model the SN light curves and spectra of stars with wave energy transport, which we can compare with SN observations to assert whether wave heating operated in the progenitors detected by HST. We will then revisit the interpretation of HST progenitor data and make predictions for future SN progenitor detections by HST.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Stellar Physics  
ID: 15072  
Program Title: The classical nova hibernation scenario: a definitive confirmation

Principal Investigator: Boris Gaensicke  
Institution: The University of Warwick

The detached white dwarf plus M-dwarf binary LL Eri exhibits truly unique behaviour within this class of compact binaries. As part of a COS snapshot survey, we detected large-amplitude variability in the ultraviolet flux of the white dwarf, confirmed by extensive ground-based blue-band photometry. The three independent frequencies detected in the light curves clearly identify this variability as non-radial pulsations of the white dwarf. However, with a hydrogen atmosphere and Teff=17200K, this white dwarf is nearly 5000K hotter than the canonical instability strip.

The COS spectrum, albeit noisy, reveals that the metal lines typically detected in this class of stars, arising from material captured from the M-dwarf wind, are very broad. If interpreted as rotationally broadened, they imply a spin of only a few minutes. Such a short period could be explained by a past phase of intense accretion of mass and angular momentum. It has been postulated for over thirty years that classical nova eruptions on the white dwarf could cause such switching from a semi-detached to a detached binary configuration, during which the system "hibernates" - yet, to date no hibernating nova has been identified.

However, the broad lines could also be due to pulsation-driven surface velocity fields, in which case the nature and past evolution of LL Eri would not be easily linked to any existing scenario for compact binary evolution.

We propose to obtain a deeper COS observations to unambiguously determine whether the cause of the observed line broadening is due to rapid rotation, which would unequivocally confirm the hibernation scenario.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: SNAP  
Scientific Category: Planets and Planet Formation  
ID: 15073  
Program Title: Extreme evolved solar systems (EESS)

Principal Investigator: Boris Gaensicke  
PI Institution: The University of Warwick

In just 20 years, we went from not knowing if the solar system is a fluke of Nature to realising that it is totally normal for stars to have planets. More remarkably, it is now clear that planet formation is a robust process, as rich multi-planet systems are found around stars more massive and less massive than the Sun. More recently, planetary systems have been identified in increasingly complex architectures, including circumbinary planets, wide binaries with planets orbiting one or both stellar components, and planets in triple stellar systems.

We have also learned that many planetary systems will survive the evolution of their host stars into the white dwarf phase. Small bodies are scattered by unseen planets into the gravitational field of the white dwarfs, tidally disrupt, form dust discs, and eventually accrete onto the white dwarf, where they can be spectroscopically detected. HST/COS has played a critical role in the study these evolved planetary systems, demonstrating that overall the bulk composition of the debris is rocky and resembles in composition the inner the solar system, including evidence for water-rich planetesimals.

Past observations of planetary systems at white dwarfs have focused on single stars with main-sequence progenitors of ~1.5 to 2.5Msun. Here we propose to take the study of evolved planetary systems into the extremes of parameter ranges to answer questions such as:

* How efficient is planet formation around 4-10Msun stars?
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15273
Program Title: A Star at the Limit? - Direct Mass Measurement of the White Dwarf in Nova Herculis 1991

Principal Investigator: Peter Garnavich

PI Institution: University of Notre Dame

V838 Her was one of the fastest fading novae ever observed. Its nebular spectrum revealed unusual abundance ratios including a high sulfur content. These observations strongly imply that the white dwarf in the system is very close to the Chandrasekhar limit and may be the most massive known. However, no direct radial velocity measurements have confirmed this assertion. Our attempt to directly measure the mass was foiled by the light of very nearby stars contaminating the nova spectra and suppressing the estimated orbital velocity of the donor star. We propose STIS high-angular resolution spectroscopy to eliminate any contamination and make a definitive, trustworthy mass measurement for the V838–Her white dwarf.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15274
Program Title: Watching Supernovae Explode: The K2 Supernova Experiment

Principal Investigator: Peter Garnavich
PI Institution: University of Notre Dame

The final campaigns of NASA’s K2 mission will be focused on the study of supernovae and extragalactic transients. To maximize the science possible from this mission we propose ultraviolet HST observations of two supernovae discovered in the K2 fields. We plan rapid ToO observations to obtain spectra during the early phases of the event to complement the continuous K2 photometry and the extensive ground-based follow-up planned for this unique opportunity. Spectroscopy and photometry in the first few hours and days after a supernova explosion provides critical information on the nature of their progenitors and physics driving the explosions. K2/Kepler provides an unprecedented cadence for photometry and has already observed nearly thirty supernovae and transients in exquisite detail as they exploded.
Legacy HST observations have enabled groundbreaking measurements of galaxy structure over cosmic time, measurements that still require theoretical interpretation in the context of a comprehensive galaxy evolution model. This proposed research aims at significantly promoting our understanding of the shapes of galaxies as quantified by their principal axes ratios. The main tool we propose to use is IllustrisTNG, a suite consisting of two of the largest cosmological hydrodynamical simulations run to date, which contain resolved galaxy populations (thousands of L∗ galaxies) that represent a state-of-the-art match to observed galaxies. In Part I of the program, we will use the simulations to create mock images and study the dependence of projected shape measurements on various factors: shape estimator, observed band, the presence of dust, radial and surface brightness cuts, and noise. We will then perform apples-to-apples comparison with observations (including HST), and provide predictions for archival as well as future observations. Further, we will quantify the intrinsic, three-dimensional, shape distribution of galaxies as a function of various galaxy parameters: redshift, mass, color, and size. In Part II of the program, we will develop theoretical insights into the physical mechanisms driving these results. We will study how galaxy shapes relate to angular momentum and merger history, and will follow the shape evolution of individual galaxies over time, looking for correlations to the evolution of other galaxy properties, e.g. size and SFR. We will also study galaxy shape relations to dark matter halo shape, thereby providing input for high-precision cosmic shear models.
Proposal Category: GO
Scientific Category: Stellar Populations
ID: 15275
Program Title: Securing HST's UV Legacy in the Local Volume: Probing Star Formation and the Interstellar Medium in Low Mass Galaxies

Principal Investigator: Karoline Gilbert
PI Institution: Space Telescope Science Institute

We propose WFC3 ultraviolet imaging of the stellar populations of a volume limited sample of 22 low-mass, nearby (<3.5 Mpc), star-forming galaxies, extending HST's resolved stellar populations legacy to include UV observations of the lowest mass and lowest metallicity star-forming environments. We will derive bolometric luminosities, effective temperatures, and constrain the line-of-sight dust extinction for millions of stars in the Local Volume. This will enable us to (1) measure the spatially- and temporally-resolved recent star formation history; (2) infer the unobscured UV flux of the stellar populations; (3) produce high resolution maps of the dust column density and grain size; and (4) reveal the drivers of dust emission. We will directly measure the quantities required to understand the link between star formation and the interstellar medium on sub-kiloparsec scales, test and calibrate widely-used star formation rate indicators, and provide critical constraints on stellar feedback processes. Our team has obtained, reduced, analyzed, and publicly released data from over 1500 orbits of HST imaging of resolved stellar populations in crowded fields, and we are already producing the above measurements for higher mass and metallicity galaxies.

The UV data will yield new insight into the baryonic physics of galaxy formation, producing quantitative constraints on the energies and timescales of interactions between gas, dust, and stars in the low-mass, low-metallicity regime. When combined with existing data from HST, Spitzer, VLA, GALEX, and CARMA, the proposed UV data will make these galaxies a benchmark for ISM studies in low metallicity environments.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: SNAP  
Scientific Category: Cosmology  
ID: 15307  
Program Title: Building the SPT-HST Legacy: Imaging Massive Clusters to z=1.5

Principal Investigator: Michael Gladders  
PI Institution: University of Chicago

We propose SNAP UVIS+IR imaging of 293 SPT galaxy clusters at 0.2<z<1.5, carefully selected from the SPT cluster catalog of more than 500 systems identified via the Sunyaev-Zel'dovich effect. The SPT clusters are a uniquely powerful resource in cluster research, being the only large sample of massive clusters spanning the entire redshift range over which such systems exist, with more than equal mass sensitivity at the highest redshifts compared to low redshift (z<0.5) systems. Using the F200LP+F110W ultra-broadband filters, our proposed SNAP data achieve maximal depth and redshift grasp in minimal time for a wide range of galaxy types: from red-and-dead galaxies in the cluster red sequence over the entire sample redshift range, star forming galaxies over the same range, and even starburst galaxies at yet higher redshifts, lensed in the cluster backgrounds. We envision three motivating science programs - all enabled for the first time over this unprecedented redshift range for massive clusters: 1) the evolution of brightest cluster galaxies through both wet and dry mergers, 2) strong lensing statistics and mass-concentration of strong lensing clusters, and 3) the X-ray-selected AGN content in clusters. These data will have a lasting legacy, and cap an extensive array of other data (both ground- and space-based, from X-ray to radio wavelengths) on these clusters. The proposed data, at a fiducial SNAP completion rate of 33%, will more than double the total number of SPT clusters with HST imaging, and add WFC3-IR imaging for a large sample for the first time, which is of particular importance to any studies of galaxy populations in these distant clusters.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Galaxies and the IGM  
ID: 15308  
Program Title: The HST Frontier Field MACS 1159.5+2223: Flanking Observations for Intracluster Light

Principal Investigator: Anthony Gonzalez  
PI Institution: University of Florida

We propose a 6 orbit WFC3/IR imaging program targeting the environs of the HST Frontier Field cluster MACS 1149.5+2223 to obtain a comprehensive view of the intracluster stellar population in a massive galaxy cluster. WFC3/IR enables a vast improvement over ground-based studies in mapping emission from diffuse stellar populations. Our proposed observations are designed to build upon the existing investment in the Frontier Fields to conduct a new, more complete census of the intracluster light (ICL) extending out to ~750 kpc. The requested observations are constructed to span the gap between the primary and parallel HFF pointings, detecting ICL to a surface brightness of 29.5 mag per square arcsec in F160W (equivalent to 31.5 mag per square arcsec in V-band). This depth is sufficient to trace the radial ICL profile out to ~750 kpc from the BCG. These data will also yield a high-fidelity calibration of the background sky level, enabling two-dimensional mapping of the distribution and color of intracluster light down to 27 mag per square arcsec in F160W. From these maps we will quantify spatial variation in the ratio of the stellar baryons to the ICM, establishing whether the observed low scatter in the global ratio masks underlying smaller scale inhomogeneities due to astrophysical processes in the cluster. The requested observations further serve as a pilot program, enabling future similar analyses with the full ensemble of HFF clusters, and developing techniques that will be required for such low surface brightness programs with upcoming facilities including Euclid and WFIRST.
Proposal Category: GO
Scientific Category: Cosmology
ID: 15276
Program Title: The lens and host galaxy of the multiply-imaged gravitationally lensed SNIa iPTF16geu

Principal Investigator: Ariel Goobar

PI Institution: Stockholm University

We request HST observations of the host galaxy and the lens of the gravitationally lensed multiply-imaged Type Ia SN iPTF16geu. These observations are required to accomplish the science outlined in the successful DD proposal of this target in Cycle 24. Since the SN will have faded by over 6 magnitudes, the Cycle 25 images will serve as references, needed to accurately measure the fluxes of the SN images through the 7 HST bands used in Cycle 24. The combined data-set will yield a precise estimate of the lensing magnification, including corrections for extinction of the SN light by dust grains in the host galaxy and in the intervening lensing galaxy. Time-delay measurements between the host galaxy subtracted SN images will be used to measure the Hubble constant.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: AR  
Scientific Category: Stellar Populations  
ID: 15023  
Program Title: Looking for Photometric Signatures of Fast Rotation in Intermediate-Age Star Clusters in the Magellanic Clouds  

Principal Investigator: Paul Goudfrooij  
PI Institution: Space Telescope Science Institute

Recently, deep color-magnitude diagrams from HST data revealed that several massive intermediate-age star clusters in the Magellanic Clouds exhibit extended main-sequence turn-offs (eMSTOs). This discovery posed serious questions regarding the mechanisms responsible for the formation of massive globular clusters and their well-known multiple stellar populations. The nature of eMSTOs is a hotly debated topic of study. Several studies argued that the eMSTOs are caused by an age range of up to a few hundred Myr, while other studies indicate that eMSTOs can instead be caused by a coeval population in which the stars span a range of rotation velocities. Formal evidence to (dis-)prove either scenario still remains at large, in part because stellar tracks that incorporate the effects of rotation have so far only been available for masses > 1.7 Msun whereas the stars in the known eMSTOs of intermediate-age star clusters are less massive. In this proposal we aim to look for photometric signatures of fast rotators in eMSTO clusters that have been observed by HST in three passbands including (at least) F336W and F814W. We will study spreads in different stellar colors, testing against those predicted with the aid of von Zeipel's geometric study for a population of rotating stars with a significant spread in their inclination. Importantly, this spread due to the presence of rotation is predicted to occur along well-defined lines in color-color diagrams, in directions that are distinct from those in color-magnitude diagrams and distinct from the spread predicted for the age range scenario.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)  
Proposal Category: GO  
Scientific Category: Planets and Planet Formation  
ID: 15168  
Program Title: The Nature of the Star-Grazing Bodies in a System at the Age of the Late Heavy Bombardment  
Principal Investigator: Carol Grady  
PI Institution: Eureka Scientific Inc.  

Studies of bodies exhibiting redshifted gaseous absorption features associated with star-grazing planetesimals offer unique data on the composition of the bodies, as well as the presence of planetesimal belt analogs and giant planets in systems throughout the stellar lifecycle. Studies of young systems, such as the A stars in the beta Pictoris moving group, suggest that the star grazing bodies contain abundant carbon and water dissociation products, indicating a cometary origin. A recent analysis of another system, phi Leo (A7 IV, age=400-900 Myr) shows similar infall features in Ca II and Ti II, with what may be a 15-year cycle. This system is similar in age to the Late Heavy Bombardment in our system, a time when terrestrial planets in our system are thought to have been veneered in organics and water. The available data indicate frequent infall events interpreted as transiting exo-comets, but sample only lithophile to super-refractory elements. Archival IUE data lack the FUV S/N to establish high carbon abundance or the presence of water dissociation products. We therefore seek COS and STIS spectra to sample the volatile gas dat, and constrain the origin of the star-grazing bodies. The FUV data will be augmented with NUV data sampling siderophiles and lithophiles.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Stellar Populations  
ID: 15277  
Program Title: Weighing Ultra-Diffuse Galaxies: Bridging the environmental gap

Principal Investigator: Johnny Greco  
PI Institution: Princeton University

Interest in ultra-low-surface brightness galaxies has been reignited by the discovery of a substantial population of ultra-diffuse galaxies (UDGs) in dense clusters. These galaxies are characterized by dwarf-like stellar masses spread across giant-galaxy sizes, and their prolonged survival in clusters suggests that they may be extremely dark-matter dominated. The dark matter halos of a handful of UDGs in dense clusters have been "weighed" by the detection of rich globular cluster (GC) systems (~20-100 GCs), and indeed, their inferred mass-to-light ratios \((M/L > 1000)\) are unprecedented for their stellar masses. More recently, galaxies with UDG-like properties have been discovered in much lower-density environments. However, the connection between UDGs across the full range of halo environments remains uncertain. Do extreme mass-to-light ratios persist throughout this population regardless of environment? Or, is this a unique characteristic of UDGs in galaxy clusters? Thanks to the depth and wide-area coverage afforded by our ongoing Hyper Suprime-Cam (HSC) Survey, we are carrying out the first truly blind search for UDGs to address this question. We currently have a sample of ~300 UDG candidates in environments ranging from the field to intermediate-mass groups. We propose to use ACS/WFC imaging to study the GC systems of 10 UDGs selected for their association with poor groups that span a range in environment a factor of ~10 to 100 less dense than Coma. Our program has the potential, for the first time, to establish a connection between the extremely dark-matter dominated UDGs in dense galaxy clusters and those being discovered in much lower-density environments.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: AR
Scientific Category: Stellar Populations
ID: 15024
Program Title: Serendipitous WFC3 Infrared Color Magnitude Diagrams of NGC4472

Principal Investigator: Michael Gregg
PI Institution: University of California - Davis

This proposal requests support for analysis of deep, four filter, wide-band WFC3/IR archival imaging data, serendipitously taken in the halo of the brightest galaxy in the Virgo cluster, the giant elliptical NGC4472. The data resolve stars well below the tip of the red giant branch with S/N of 5. These data will produce various IR color magnitude diagrams of the upper red and asymptotic giant branch populations. Comparison of the location and width of the red giant branch locus with theoretical isochrones will yield mean metallicity and abundance spread measurements of the halo population of NGC4472. These data will also determine a secure distance from the luminosity of the observed giant branch tip in the IR. Detection or limits on intermediate age populations will be extracted from analysis of the asymptotic giant branch population. The resulting mean metallicity, metallicity distribution function, and constraints on intermediate age populations will be the first such data for a luminous elliptical in a rich cluster of galaxies. The results will provide meaningful input and testing of massive elliptical galaxy formation. This program also serves as a preparatory project for a JWST Early Release Science program which shares some of the same science goals and analysis methods.
Proposal Category: GO
Scientific Category: Stellar Populations
ID: 15169
Program Title: Resolving Multiple Stellar Populations in G1

Principal Investigator: Michael Gregg
PI Institution: University of California - Davis

The most luminous and massive compact stellar system in the Local Group is G1, a satellite of M31. It has been speculated that G1 is the remnant nucleus of a tidally stripped dwarf elliptical galaxy. As such, G1 is key to understanding both the evolution of dwarf galaxies and the hierarchical assembly of bright spirals. Recently, new U-B-V-I broad band imaging techniques have revealed multiple stellar populations in Milky Way globular clusters. We propose to obtain new deep WFC3/UVIS F336W and F814W images, to be combined with archival WFC3 data, to probe the star formation and enrichment history of G1. This study will yield new and definitive insights into the origin and evolution of G1, the relationship of globular clusters to dwarf galaxies, and the formation of luminous spirals like M31 and the Milky Way.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: SNAP
Scientific Category: Galaxies and the IGM
ID: 15170

Program Title: Snapshot Survey of the Globular Cluster Populations of Isolated Early Type Galaxies

Principal Investigator: Michael Gregg

PI Institution: University of California - Davis

We propose WFC3/UVIS snapshot observations of a sample of 75 isolated early type galaxies residing in cosmic voids or extremely low density regions. The primary aim is to use their globular cluster populations to reconstruct their evolutionary history, revealing if, how, and why void ellipticals differ from cluster ellipticals. The galaxies span a range of luminosities, providing a varied sample for comparison with the well-documented globular cluster populations in denser environments. This proposed WFC3 study of isolated early type galaxies breaks new ground by targeting a sample which has thus far received little attention, and, significantly, this will be the first such study with HST. Characterizing early type galaxies in voids and their GC systems promises to increase our understanding of galaxy formation and evolution of galaxies in general because isolated objects are the best approximation to a control sample that we have for understanding the influence of environment on formation and evolution. Whether these isolated objects turn out to be identical to or distinct from counterparts in other regions of the Universe, they will supply insight into the formation and evolution of all galaxies. Parallel ACS imaging will help to characterize the near field environments of the sample.
Proposal Category: GO
Scientific Category: Solar System
ID: 15233
Program Title: Density of transneptunian object 229762 2007 UK126

Principal Investigator: Will Grundy
PI Institution: Lowell Observatory

Densities provide unique information about bulk composition and interior structure and are key to going beyond the skin-deep view offered by remote-sensing techniques based on photometry, spectroscopy, and polarimetry. They are known for a handful of the relict planetesimals that populate our Solar System’s Kuiper belt, revealing intriguing differences between small and large bodies. More and better quality data are needed to address fundamental questions about how planetesimals form from nebular solids, and how distinct materials are distributed through the nebula. Masses from binary orbits are generally quite precise, but a problem afflicting many of the known densities is that they depend on size estimates from thermal emission observations, with large model-dependent uncertainties that dominate the error bars on density estimates. Stellar occultations can provide much more accurate sizes and thus densities, but they depend on fortuitous geometry and thus can only be done for a few particularly valuable binaries. We propose observations of a system where an accurate density can be determined: 229762 2007 UK126. An accurate size is already available from multiple stellar occultation chords. This proposal will determine the mass, and thus the density.
Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15203
Program Title: First exploration of a single thermal interface between the two dominant phases of the interstellar medium

Principal Investigator: Cecile Gry
PI Institution: Laboratoire d’Astrophysique de Marseille

Two phases of the interstellar medium, the Warm Neutral Medium (WNM) and the Hot Ionized Medium (HIM) occupy most of the volume of space in the plane of our Galaxy. Because the boundaries between these phases are important sources of energy loss for the hot gas, they are supposed to play an important role in the thermal structure and evolution of the ISM and of galaxies.

Many theorists have created descriptions of the nature of such boundaries and have derived two fundamental concepts: (1) a conductive interface and (2) a turbulent mixing layer.

We have yet to observe in detail either kind of boundary. This is achieved by using UV absorption lines of moderately high ionization stages of heavy elements. Yet, over most lines of sight the diagnostics are blurred out by the superposition of different regions with vastly different physical conditions, making them difficult to interpret. To characterize the nature of the physical processes at a boundary one must observe along a sight line that penetrates just one such region. The simplest configuration is the outer boundary of the Local Cloud, the WNM ((T ~ 7000 K) that surrounds the Sun and which is embedded in a very low density, soft X-ray emitting hot medium (~ 10^6 K) that fills a cavity (~ 200 pc in diameter) called the Local Bubble.

We propose to observe an ideal target: a nearby, bright B9V star (i.e. hot enough to provide a high-SNR continuum, but not enough to contaminate it with absorptions from circumstellar high-ionization species), located in a direction where the relative orientation of the magnetic field and the cloud boundary does not quench thermal conduction and thus favors a full extent of the interface.
Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15204
Program Title: Testing our scenario of a failed wind for TW Hya

Principal Investigator: Hans Guenther

PI Institution: Massachusetts Institute of Technology

Young, accreting low-mass stars show strong, broad and asymmetric FUV emission lines. When multiple observations of the same wavelength region exist, we often see that the flux and profile of these lines change strongly between the observations. Observationally, this is poorly characterized, and theoretically, neither the lines profiles nor their variability can be explained. In 2011 we tried to remedy this situation by monitoring the classical Tauri star TW Hya for 10 orbits with HST/COS. At the time, the literature suggested that the variability could be due to a hot stellar wind and thus we distributed the observations over one month, which would have been the appropriate time scale. As it turns out, this assumption appears to have been wrong. The data we received clearly shows that no hot wind is present and that all variability happens on much shorter time scales. In this proposal, we show that we have done a thorough analysis of the existing data and we have a model to explain it. Now, we ask for additional monitoring of TW Hya to cover the time scale of a few hours - as we now know this is the relevant time scale to understand the variability.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: AR  
Scientific Category: Galaxies and the IGM  
ID: 15025  
Program Title: Dwarfs in the Deepest Fields at Noon: Studying Size and Shape of Low-mass Galaxies out to $z \sim 3$ in Five HST Legacy Fields  
Principal Investigator: Yicheng Guo  
PI Institution: University of California - Santa Cruz

Galaxies with stellar mass $100x$-$1000x$ times smaller than our Milky Way (hereafter dwarf galaxies or DGs) are important for understanding galaxy formation and evolution by being the most sensitive probes of both the macro-physics of dark matter halos and the micro-physics of the different physical mechanisms that regulate star formation and shape galaxies. Currently, however, observations of distant DGs have been hampered by small samples and poor quality due to their faintness. We propose an archival study of the size, morphology, and structures of DGs out to $z \sim 3.0$ by combining the archived data from five of the deepest regions that HST has ever observed: eXtreme Deep Field (XDF, updated from HUDF) and the Hubble Legacy Fields (HLFs). Our program would be the first to advance the morphology studies of DGs to the Cosmic Noon ($z \sim 2$), and hence place unprecedented constraints on models of galaxy structure formation. Equally important is the data product of our program: multi-wavelength photometry and morphology catalogs for all detected galaxies in these fields. These catalogs would be a timely treasure for the public to prepare for the coming JWST era by providing detailed information of small, faint, but important objects in some deepest HST fields for JWST observations.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Massive Black Holes And Their Host Galaxies
ID: 15309
Program Title: Does the Relativistic X-Ray Outflow Quasar PDS 456 Have the Fastest-Ever UV BAL at ~0.3c?

Principal Investigator: Fred Hamann
PI Institution: University of California - Riverside

The quasar PDS 456 (z=0.184) is a prototype for relativistic accretion-disk outflows measured in X-rays. The X-ray features are highly-variable, revealing speeds up to 0.25-0.3c, total column densities N_H > 10^23 cm^-2, a high degree of ionization (FeXXVI), and large outflow kinetic energies that could drive feedback to the host galaxy. This powerful outflow presents a challenge for theoretical models to understand its acceleration, origins, and spatial structure. It has attracted 19.3 days(!) of observing time on X-ray telescopes. In contrast, there have been only 2 HST observations totaling 3 orbits to measure the broad UV outflow lines in this quasar. An HST-STIS spectrum revealed a single broad absorption line (BAL) at ~1350A (observed) that was identified as Ly-alpha at a pedestrian speed of ~0.05c, which is typical of BALs in other quasars. However, the Ly-alpha ID is problematic because it is not accompanied by metal lines at the same speed; this would be unique among BAL outflows requiring extremely low column densities, N_H < 10^19 cm^-2, a low degree of ionization, and possibly large distances from the quasar. We argue that the UV BAL is, instead, CIV at velocity ~0.3c. This would be the fastest UV outflow ever reported, the first direct link of UV BALs to relativistic X-ray outflows, and the first evidence supporting models where UV BALs drive X-ray outflow accelerations. We propose two 3-orbit observation of PDS 456 with COS G140L to test the Ly-alpha versus CIV BAL identification, study the BAL variability, confirm/search for other broad outflow lines in the UV spectrum, and obtain better constraints on the UV outflow location and physical conditions.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Stellar Physics  
ID: 15234  
Program Title: Collecting the Missing Piece of the Puzzle: The Wind Temperatures of Arcturus (K2 III) and Aldebaran (K5 III)

Principal Investigator: Graham Harper  
PI Institution: University of Colorado at Boulder  

Unravelling the poorly understood processes that drive mass loss from red giant stars requires that we empirically constrain the intimately coupled momentum and energy balance. Hubble high spectral resolution observations of wind scattered line profiles, from neutral and singly ionized species, have provided measures of wind acceleration, turbulence, terminal speeds, and mass-loss rates. These wind properties inform us about the force-momentum balance, however, the spectra have not yielded measures of the much needed wind temperatures, which constrain the energy balance.

We proposed to remedy this omission with STIS E140H observations of the Si III 1206 Ang. resonance emission line for two of the best studied red giants: Arcturus (alpha Boo: K2 III) and Aldebaran (alpha Tau: K5 III), both of which have detailed semi-empirical wind velocity models. The relative optical depths of wind scattered absorption in Si III 1206 Ang., O I 1303 Ang. triplet., C II 1335 Ang., and existing Mg II h & k and Fe II profiles give the wind temperatures through the thermally controlled ionization balance. The new temperature constraints will be used to test existing semi-empirical models by comparison with multi-frequency JVLA radio fluxes, and also to constrain the flux-tube geometry and wave energy spectrum of magnetic wave-driven winds.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15235
Program Title: The Perseus Cluster: Bridging the Extremes of Stellar Systems

Principal Investigator: William Harris
PI Institution: McMaster University

The Perseus cluster (Abell 426) at d=75 Mpc is as massive and diverse as Virgo and Coma and displays a rich laboratory for studying galaxy evolution. Its massive X-ray halo gas component and its high proportion of large early-type galaxies point to a long history of dynamical interaction amongst the cluster members. The central supergiant, NGC 1275, is perhaps the most active galaxy in the local universe, with a spectacular network of H-alpha filaments, cooling flows, feedback, and prominent star formation in plain view.

We propose to use the Globular Cluster (GC) populations in the Perseus region with two-band imaging to pursue three connected goals: the stellar Intracluster Medium (ICM); its Ultra-Diffuse Galaxies (UDGs); and the GC populations in the Perseus core galaxies. Our analysis of a few HST/ACS Archival images covering the Perseus core strongly indicates that a substantial Intragalactic GC component is present. Our newly discovered sample of UDGs in Perseus covers the entire parameter space of these intriguing galaxies and will be thoroughly sampled in our study: are they "failed" underluminous galaxies with high masses, or are they a mixed bag? For all our goals, the GC populations will act as powerful tracers of the dominant old stellar populations -- their metallicity distributions and total populations in the ICM, the UDGs, and the three largest E galaxies in Perseus. As a bonus, we expect to find ~200 new Ultra-Compact Dwarfs (UCDs) and half a dozen rare compact ellipticals (cEs). The scientific payoffs will include a broader understanding of the nature and history of all these types of galaxies and their stripped stellar material.
Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15257
Program Title: Proper Motions, Shear, Mass-Loss Rates and C-Shocks in the HH 7-11 Jet

Principal Investigator: Patrick Hartigan
PI Institution: Rice University

We propose to obtain the first complete set of narrow band HST images of the iconic HH 7-11 protostellar jet. Owing to positional errors, both previous attempts to image the system failed to capture the HH 7 bow shock, arguably the best example we have of a well-resolved, strong shock in molecular gas. The proposed observations will tie together the optical and the IR emission in HH 7 and establish whether the molecular gas is heated by a continuous shock or a jump shock, physics of direct relevance to upcoming JWST observations of protostars. HST is needed to measure proper motions, to detect offsets between H-alpha and the forbidden lines that define the directions of shock propagation throughout the flow, and to resolve small scale structures present in the previous images. The portions of the jet imaged in 1995 and 1998 show several curious features, including two `rings' that may result from the jet penetrating through preexisting sheets or filaments. If this explanation is correct, the shocks in the rings will have expanded perpendicular to the axis of the jet by measurable amounts in the last 20 years. Any shear or entrainment along the jet will manifest itself as differential motions in the shocked gas. Our proposal employs a WFC3 quad filter to measure electron densities at each pixel. Combined with proper motion measurements, these observations will allow us to separate jet material from shocked gas along the cavity, observe dynamical instabilities if they exist behind the shock, and assess the accuracy of simple mass loss calculations that depend solely upon integrated line luminosities.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Galaxies and the IGM  
ID: 15340  
Program Title: The HST-pNFL program: Mapping the Fluorescent Emission of Galactic Outflows

Principal Investigator: Timothy Heckman  
PI Institution: The Johns Hopkins University

Galactic outflows associated with star formation are believed to play a crucial role in the evolution of galaxies and the IGM. Most of our knowledge about outflows has come from "down-the-barrel" UV absorption spectroscopy of star-forming galaxies. However, absorption-line data alone provide only indirect information about the radial structure of the gas flows, which introduces large systematic uncertainties in some of the most important quantities, such as the outflow rate, the mass loading factor, and the momentum, metal, and energy fluxes. Recent spectroscopic observations of star-forming galaxies with large (projected physical) apertures have revealed non-resonant (fluorescent) emission in the UV, e.g., Fell* and Sill*, that can be naturally produced by spatially extended emission from the same outflowing material traced in absorption. Encouraged by the most recent observations of Fell* emission by the SDSS-IV/eBOSS survey (Zhu et al. 2015), we propose a pilot program to use narrow-band filter UVIS F280N images to map the extended Fell* 2626 and 2613 fluorescent emission in a carefully-chosen sample of 4 starburst galaxies at z=0.065, and COS G130M to obtain down-the-barrel spectra for Sill absorption and Sill* emission. This HST pilot program can provide unique information about the spatial structure of galactic outflows and can potentially lead to a revolution in our understanding of outflow physics and its impact on galaxies and the IGM.
Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15341
Program Title: Testing a New Method for Finding Leaky Galaxies: Implications for the Epoch of Reionization
Principal Investigator: Timothy Heckman
PI Institution: The Johns Hopkins University

One of the core missions of JWST will be understanding the Epoch of Reionization (EOR), which traces the formation of the earliest progenitors of present-day galaxies. A major uncertainty is the relative amount of ionizing Lyman Continuum (LyC) photons that can escape from these early galaxies. Unfortunately, it is not possible to directly measure the leakage of LyC photons from galaxies during the EOR. The best strategy is to find lower redshift galaxies that are leaking LyC photons, and to use these analogs to both understand the physical processes that make this leakage possible and to identify reliable indirect signposts of leaky galaxies that could be measured with JWST.

We propose to test one such promising signpost: the relative weakness of the [SII]6717,6731 emission-lines. The lines are produced near and just beyond the outer edge of a Stromgren sphere. In conditions when the gas is optically-thin to LyC photons (allowing leakage) these lines therefore become weak. Our specific goal is to directly observe the rest-frame LyC in five galaxies chosen to have unusually weak SII. If we succeed, this would provide a new signpost for JWST to characterize leaky galaxies during the EOR.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15074
Program Title: Identifying the donor star of the most extreme ULX pulsar

Principal Investigator: Marianne Heida
PI Institution: California Institute of Technology

Ultraluminous X-ray sources (ULXs) were once among the most promising candidates for long sought after intermediate-mass black holes, owing to their high X-ray luminosities (>10^39 erg/s) and off-nuclear positions. NGC 5907 ULX-1 was a prime example, and since it regularly reaches 10^41 erg/s it was thought to harbour a black hole with a mass of at least 500 solar masses. But in an astonishing discovery, the source was found to exhibit pulsations in the X-rays on second-timescales, revealing it to be a pulsar powered by accretion onto a neutron star with only 1.4 solar masses. This discovery challenges every known theory of accretion onto a compact object, which in this object exceeds the Eddington limit by a factor of 500. It requires us to imagine extreme departures from known accretion theory and/or binary evolution scenarios. The fuel source should be a massive companion star in order to sustain the required mass accretion rate, however X-ray timing favors a low-mass star. With the ability to detect a massive star, a short HST/WFC3 NIR observation would solve this mystery. A detection of a supergiant donor would open the path to future dynamical mass measurements with JWST, while a non-detection would prove that this extreme ULX pulsar contains a low-mass donor star, forcing us to consider new evolutionary formation channels.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: AR  
Scientific Category: Massive Black Holes And Their Host Galaxies  
ID: 15026  
Program Title: Characterizing the Physical Mechanisms Driving Feeding and Feedback in Active Galaxies

Principal Investigator: Erin Hicks  
PI Institution: University of Alaska Anchorage

While the significance of supermassive black holes (BH) in galaxy evolution is now widely acknowledged, models of the processes regulating the BH-host galaxy relationship are poorly constrained. We will address this with a new analysis of archival broad-band and narrow-band HST imaging combined with direct kinematic measurements of the inflows and outflows in those same local Seyfert galaxies. The Keck OSIRIS Nearby AGN (KONA) survey of nearby bona fide Seyfert galaxies gives a statistically significant characterization of feeding and feedback in the central few hundred parsecs of Seyfert AGN. Dust structure and color maps trace the inflowing molecular gas measured with OSIRIS, while the narrow line region imaged in narrow-band HST data traces the outflowing ionized gas. Only with the larger field of view of HST imaging is it possible to reliably identify inflow mechanisms, constrain orientation of nuclear spiral and bar structures, and characterize the morphology of the NLR including extent, opening angle, and orientation. These are essential inputs to modeling of the inflow and outflow kinematics measured within the central few hundred parsecs of the KONA galaxies. With this informed interpretation of the inflow and outflow kinematics, and the modeling enabled through comparison with HST imaging, we can then address the key issues of (i) what is the primary inflow mechanism(s) and how are these processes related to fundamental AGN and host galaxy properties?, and (ii) under what conditions can the AGN drive an outflow that substantially modifies the ISM and thus the evolution of the host galaxy?
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Solar System
ID: 15171
Program Title: The rotation period, orbit, and mass of Eris’ satellite Dysnomia

Principal Investigator: Bryan Holler
PI Institution: Space Telescope Science Institute

Almost 80 satellite systems have been identified in the trans-Neptunian region in the outer Solar System. These systems fall into two classes: equal mass, wide separation binaries and large primaries with relatively small satellites. The existence of these two distinct classes suggests different formation mechanisms of capture and giant impact, respectively, but there is no way to confirm this without more in-depth observations of a given system. Little is known about the majority of these satellite systems besides the orbital period and the relative brightness of the components. The orbital period provides the total system mass but does nothing to constrain the masses of the individual components. The mass and rotation period of the satellite can provide valuable information about the tidal state and thus the formation mechanism of the second class of binary systems. Previous observations of large trans-Neptunian objects (TNOs) with multiple satellites point to formation by giant impact, but never before has this kind of investigation been performed for a large TNO with only one satellite. In this work, we propose to observe Eris and its satellite Dysnomia with the WFC3 instrument to provide useful constraints on the mass Dysnomia, calculate Dysnomia’s rotation period, and compute an improved orbit solution for Dysnomia, with the ultimate goal of understanding the origin of this and other large TNO binary systems.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Galaxies and the IGM  
ID: 15105  
Program Title: Dusty Dwarfs Galaxies Occulting A Bright Background Spiral  

Principal Investigator: Benne Holwerda  
PI Institution: University of Louisville Research Foundation, Inc.

The role of dust in shaping the spectral energy distributions of low mass disk galaxies remains poorly understood. Recent results from the Herschel Space Observatory imply that dwarf galaxies contain large amounts of cool (T~20K) dust, coupled with very modest optical extinctions. These seemingly contradictory conclusions may be resolved if dwarfs harbor a variety of dust geometries, e.g., dust at larger galactocentric radii or in quiescent dark clumps.

We propose HST observations of six truly occulting dwarf galaxies drawn from the Galaxy Zoo catalog of silhouetted galaxy pairs. Confirmed, true occulting dwarfs are rare as most low-mass disks in overlap are either close satellites or do not have a confirmed redshift. Dwarf occulters are the key to determining the spatial extent of dust, the small scale structure introduced by turbulence, and the prevailing dust attenuation law. The recent spectroscopic confirmation of bona-fide low mass occulting dwarfs offers an opportunity to map dust in these with HST. What is the role of dust in the SED of these dwarf disk galaxies? With shorter feedback scales, how does star-formation affect their morphology and dust composition, as revealed from their attenuation curve?

The resolution of HST allows us to map the dust disks down to the fine scale structure of molecular clouds and multi-wavelength imaging maps the attenuation curve and hence dust composition in these disks. We therefore ask for 2 orbits on each of 6 dwarf galaxies in F275W, F475W, F606W, F814W and F125W to map dust from UV to NIR to constrain the attenuation curve.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15106
Program Title: The UV attenuation in JWST target VV 191

Principal Investigator: Benne Holwerda
PI Institution: University of Louisville Research Foundation, Inc.

We aim to map the UV--near--IR attenuation curve along many sightlines within nearby disk galaxies to resolve a large fundamental uncertainty in galaxy evolution studies: the variance in the attenuation curve within an individual galaxy disk on linear scales <50pc, and the prevalence of the 2175 Angstrom "bump" specifically. We developed a technique to obtain spatially-resolved attenuation measurements using overlapping ("occulting") galaxy pairs. The GalaxyZoo citizen science project and our STARSMOG HST/ACS F606W snapshot survey have only recently identified and validated overlapping pairs with a geometry that lends itself particularly well for such analysis.

The most promising pair, VV 191, will be observed as JWST/NIRCam GTO targets to cover the near-IR part of the attenuation curves. To complement the JWST NIR observations with UV, we request WFC3/UVIS observations in the F225W and F336W filters. These cover (together with the existing F606W ACS images) the UV--visible portion of the UV--near--IR attenuation curves for each <50pc resolution element in the region of overlap in the non-interacting galaxy pair VV191 (MCG+04-33-005), in which a relatively blue elliptical beautifully backlights the outer disk of a foreground face-on spiral galaxy.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Galaxies and the IGM  
ID: 15107  
Program Title: The Cluster Population of UGC 2885

Principal Investigator: Benne Holwerda  
PI Institution: University of Louisville Research Foundation, Inc.

UGC 2885 was discovered to be the most extended disk galaxy [250 kpc diameter] by Vera Rubin in the 1980's. We ask for HST observations of UGC 2885 as it is close enough to resolve the GC population with HST but it is a substantially more extended disk than any studied before. LCDM galaxy assembly implies that the GC population comes from small accreted systems and the disk --and the clusters associated with it-- predominately from gas accretion (matching angular momentum to the disk). Several scaling relations between the GC population and parent galaxy have been observed but these differ for disk and spheroidal (massive) galaxies.

We propose to observe this galaxy with HST in 4 point WFC3 mosaic with coordinated ACS parallels to probe both the disk and outer halo component of the GC population. GC populations have been studied extensively using HST color mosaics of local disk galaxies and these can serve as comparison samples. How UGC 2885 cluster populations relate to its stellar and halo mass, luminosity and with radius will reveal the formation history of extra-ordinary disk.

Our goals are twofold: our science goal is to map the luminosity, (some) size, and color distributions of the stellar and globular clusters in and around this disk. In absolute terms, we expect to find many GC but the relative relation of the GC population to this galaxy's mass (stellar and halo) and size will shed light on its formation history; similar to a group or cluster central elliptical or to a field galaxy (albeit one with a disk 10x the Milky Way's size)? Our secondary motive is to make an HST tribute image to the late Vera Rubin.
Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15236
Program Title: The mystery of a supposed massive star exploding in a brightest cluster galaxy
Principal Investigator: Griffin Hosseinzadeh
PI Institution: Las Cumbres Observatory Global Telescope Network

Most of the diversity of core-collapse supernovae results from late-stage mass loss by their progenitor stars. Supernovae that interact with circumstellar material (CSM) are a particularly good probe of these last stages of stellar evolution. Type Ibn supernovae are a rare and poorly understood class of hydrogen-poor explosions that show signs of interaction with helium-rich CSM. The leading hypothesis is that they are explosions of very massive Wolf-Rayet stars in which the supernova ejecta excites material previously lost by stellar winds. These massive stars have very short lifetimes, and therefore should only found in actively star-forming galaxies. However, PS1-12sk is a Type Ibn supernova found on the outskirts of a giant elliptical galaxy. As this is extraordinary unlikely, we propose to obtain deep UV images of the host environment of PS1-12sk in order to map nearby star formation and/or find a potential unseen star-forming host. If star formation is detected, its amount and location will provide deep insights into the progenitor picture for the poorly-understood Type Ibn class. If star formation is still not detected, these observations would challenge the well-accepted hypothesis that these are core-collapse supernovae at all.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15075
Program Title: The CGM of Massive Galaxies: Where Cold Gas Goes to Die?

Principal Investigator: Jay Howk
PI Institution: University of Notre Dame

We propose to survey the cold HI content and metallicity of the circumgalactic medium (CGM) around 50 (45 new, 5 archival) z=0.5 Luminous Red Galaxies (LRGs) to directly test a fundamental prediction of galaxy assembly models: that cold, metal-poor accretion does not survive to the inner halos of very massive galaxies. Accretion and feedback through the CGM play key roles in our models of the star formation dichotomy in galaxies. Low mass galaxies are thought to accrete gas in cold streams, while high mass galaxies host hot, dense halos that heat incoming gas and prevent its cooling, thereby quenching star formation. HST/COS has provided evidence for cold, metal-poor streams in the halos of star-forming galaxies (consistent with cold accretion). Observations have also demonstrated the presence of cool gas in the halos of passive galaxies, a potential challenge to the cold/hot accretion model. Our proposed observations will target the most massive galaxies and address the origin of the cool CGM gas by measuring the metallicity. This experiment is enabled by our novel approach to deriving metallicities, allowing the use of much fainter QSOs. It cannot be done with archival data, as these rare systems are not often probed along random sight lines. The H I column density (and metallicity) measurements require access to the UV. The large size of our survey is crucial to robustly assess whether the CGM in these galaxies is unique from that of star-forming systems, a comparison that provides the most stringent test of cold-mode accretion/quenching models to date. Conversely, widespread detections of metal-poor gas in these halos will seriously challenge the prevailing theory.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Stellar Physics  
ID: 15076  
Program Title: The Recent Mass Loss History of the Red Hypergiant VY CMa

Principal Investigator: Roberta Humphreys  
PI Institution: University of Minnesota - Twin Cities

The high mass loss episodes observed in evolved massive stars across the HR Diagram remain a mystery. With its very visible discrete ejecta, VY CMa is the perfect star to explore the origin of these events in the evolved yellow and red supergiants. VY CMa's high mass loss rate and its unusual chemistry suggest that it is near the end of the red supergiant stage or possibly in a second short-lived red supergiant stage. Its HST/WFPC2 images are distinguished by prominent large-scale arcs and clumps of knots with minimum masses of $3 \times 10^{-3}$ Msun. They were ejected in separate events over the past 800 years in different directions by localized processes from different regions on the star. The physical mechanism that drives these high mass loss events is not understood, but the evidence increasingly suggests that surface activity and magnetic fields are important. The circumstellar ejecta is also filled with numerous small knots and filaments suggesting that this mass loss process has been more frequent. ALMA measurements of the polarization in the dust closest to the star reveals grains aligned by the local magnetic field via a process that must be occurring on relatively short time scales. This material contains dust from the most recent mass loss events. Our proposed observations of the small knots and filaments closest to the star are designed to probe VY CMa's innermost circumstellar ejecta, the frequency of the recent ejections, and set limits on the timescales for the mass loss process.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: AR
Scientific Category: Cosmology
ID: 15027
Program Title: Completing the Legacy of Hubble's Wide/Deep Fields: An Aligned Complete Dataset of 1220 Orbits on the GOODS-N/CANDELS-N Region

Principal Investigator: Garth Illingworth
Pl Institution: University of California - Santa Cruz

The GOODS-N/CANDELS-N region is second only to the GOODS-S/ECDF-S region in the extent of its HST and Spitzer coverage, making it a remarkable science resource. Yet of 1220 orbits of ACS and WFC3/IR imaging from 27 programs on the GOODS-N region, fully 42% of the total, about 520 orbits of imaging data from 22 programs, remains unavailable in MAST as a high-level science data product (HLSP). The GOODS-N region dataset is a key Legacy field (~3 Msec from HST, 6 Msec from Spitzer, and 2 Msec from Chandra). We propose to deliver, with catalogs, HST ACS and WFC3/IR HLSPs to MAST for all 1220 orbits of GOODS-N data. We will also deliver HLSPs for the EGS, UDS and the COSMOS CANDELS regions, including new data not included to date. These four HLSPs, ~2300 orbits of HST data (~75% of a HST Cycle!), will add substantially to (1) our understanding of the build-up of galaxies to z~6 in the first Gyr during reionization, (2) the development of galaxies over the subsequent Gyr to the peak of the star formation rate in the universe at z~2-3, and (3) the transition at z<2 of early star-forming galaxies to the full splendor of the Hubble sequence. We can do this major AR Legacy program, having submitted a HLSP of ALL 2442 orbits of HST data on the GOODS-S region (>950 orbits new). The total volume of data in the GOODS-S Hubble Legacy Field (HLF-GOODS-S) is 5.8 Msec in 7211 exposures (~70% of a HST cycle). The HLF-GOODS-S includes 4 new deep areas akin to the HUDF/XDF. The four proposed NEW Hubble Legacy Field datasets will complement the Frontier Field datasets and our recent HLF-GOODS-S and HUDF/XDF HLSP submissions. They will be cornerstones of Hubble's Legacy as the JWST era dawns.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15136
Program Title: Lyman alpha emission in nearby star-forming galaxies with the lowest metallicities and the highest [OIII]/[OII] ratios

Principal Investigator: Yuri Izotov

PI Institution: Ukrainian National Academy of Sciences, MAO

The Lyman alpha line of hydrogen is the strongest emission line in galaxies and the tool of predilection for identifying and studying star-forming galaxies over a wide range of redshifts, especially in the early universe. However, it has become clear over the years that not all of the Lyman alpha radiation escapes, due to its resonant scattering on the interstellar and intergalactic medium, and absorption by dust. Although our knowledge of the high-z universe depends crucially on that line, we still do not have a complete understanding of the mechanisms behind the production, radiative transfer and escape of Lyman alpha in galaxies. We wish here to investigate these mechanisms by studying the properties of the ISM in a unique sample of 8 extreme star-forming galaxies (SFGs) that have the highest excitation in the SDSS spectral data base. These dwarf SFGs have considerably lower stellar masses and metallicities, and higher equivalent widths and [OIII]5007/ [OII]3727 ratios compared to all nearby SFGs with Lyman alpha emission studied so far with COS. They are, however, very similar to the dwarf Lyman alpha emitters at redshifts ~3-6, which are thought to be the main sources of reionization in the early Universe. By combining the HST/COS UV data with data in the optical range, and using photoionization and radiative transfer codes, we will be able to study the properties of the Lyman alpha in these unique objects, derive column densities of the neutral hydrogen N(HI) and compare them with N(HI) obtained from the HeI emission-line ratios in the optical spectra. We will derive Lyman alpha escape fractions and indirectly Lyman continuum escape fractions.
Proposal Category: AR
Scientific Category: Galaxies and the IGM
ID: 15028
Program Title: Simulating pre-galactic metal enrichment for JWST deep-field observations

Principal Investigator: Jason Jaacks
PI Institution: University of Texas at Austin

We propose to create a new suite of mesoscale cosmological volume simulations with custom built sub-grid physics in which we independently track the contribution from Population III and Population II star formation to the total metals in the interstellar medium (ISM) of the first galaxies, and in the diffuse IGM at an epoch prior to reionization. These simulations will fill a gap in our simulation knowledge about chemical enrichment in the pre-reionization universe, which is a crucial need given the impending observational push into this epoch with near-future ground and space-based telescopes. This project is the natural extension of our successful Cycle 24 theory proposal (HST-AR-14569.001-A; PI Jaacks) in which we developed a new Pop III star formation sub-grid model which is currently being utilized to study the baseline metal enrichment of pre-reionization systems.
Proposal Category: GO
Scientific Category: Cosmology
ID: 15278
Program Title: UV-Visible Imaging of the JWST NEP Time-Domain Field: the *best* extragalactic survey field *always* accessible to JWST

Principal Investigator: Rolf Jansen
PL Institution: Arizona State University

We propose UV-Visible imaging of the *best* field in JWST’s Continuous Viewing Zones where one can conduct a deep and wide extragalactic survey at *arbitrary* cadence and orientation. This 7’ radius time-domain field near the North Ecliptic Pole (1) is devoid of sources brighter than m_AB~16 at ~4 micron, (2) has low Galactic foreground extinction, (3) was proven suitable to m_AB~26 mag in deep ground-based images, (4) includes a self-calibrator source for VLA/VLBA radio observations, and allows follow-up with other space- and major ground-based facilities from X-ray through radio. From our proposed HST imaging to m_AB~28 mag (the JWST spectroscopy limit) we will set the table for JWST, with (a) the first two-epoch (37-73 day) baseline for time-domain science (AGN, SNe, proper motions), and (b) identification of ultra-high-z imposters: rest-frame UV-bright objects at z<~6 that would contaminate JWST ultra-high redshift galaxy samples. From extant data and these proposed HST observations we aim to:

(1) Establish a baseline UV-Visible detection image at ~0.05” FWHM, and provide a map of transients and objects moving on 37-73 day time scales;
(2) Identify galaxies with UV-Visible SEDs with significant non-thermal emission (weak AGN, QSOs), assess the possible escape of LyC photons at 2<z<3, and place limits on that escape and IGM porosity at 3<z<5.6;
(3) Study mass assembly and evolution of all significantly resolved UV-bright galaxies at z<~6 on a 'pixel-by-pixel' basis.

In order to maximize the scientific return of early-release JWST science, it is critical to image this field in the
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: AR
Scientific Category: Planets and Planet Formation
ID: 15029
Program Title: An Archival Study of Atomic Constituents in Four Edge-on Debris Disk Systems

Principal Investigator: Edward Jenkins
PI Institution: Princeton University

Debris disks around stars are thought to evolve from gas-rich protoplanetary disks and eventually lead to the formation of exoplanet systems. Millimeter, sub-millimeter and far IR observations tell us much about the nature of solid and molecular constituents, but UV absorptions in the spectra of stars central to edge-on disks reveal the nature of atomic gas constituents that lie within such systems. The debris disks around the stars Beta Pictoris and 49 Ceti have already been studied in some detail. We propose to expand the sample by studying four more such targets that were observed with STIS in the highest resolution echelle modes, and this investigation will significantly expand our understanding of intrinsically different systems or ones with different angles of inclination with respect to our sightline. We plan to measure element abundances, which should lead to insights on the composition of the orbiting material. Also, we expect to learn more about the local physical conditions by evaluating the relative populations of atoms in metastable electronic states and fine-structure levels of the ground states.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: AR  
Scientific Category: Stellar Populations  
ID: 15030  
Program Title: The Role of Environment in the SFHs and Gaseous Evolution of Ultra-Faint Dwarf Galaxies across Cosmic Time

Principal Investigator: Myoungwon Jeon  
PI Institution: University of Arizona

Ultra faint dwarf (UFD) galaxies (Mv > -7; Mstar < 10^5 Msun) are the least massive satellites of the Milky Way (MW) and M31. They are believed to be the relics of the first galaxies, making them ideal targets to hunt for chemical signatures of the first generation of stars. Star formation histories (SFHs) derived from deep HST/ACS imaging of several MW UFDs illustrate quenching of the era of reionization. However, new HST studies of the faintest dwarfs about M31 recently revealed more diverse SFHs, indicating that a wide range of evolutionary paths are possible for UFDs. Interpretation of these data is not possible without hydrodynamic cosmological simulations that account for not only the impact of reionization and stellar feedback, but also the host environment. Such simulations do not currently exist. We propose to create a large suite of cosmological, hydrodynamic simulations of UFD analogs that reside ~ 100 kpc from a MW type host at z = 0. These novel simulations will allow us to quantify the role of host's tidal field on the SFHs and gaseous evolution of UFDs for the first time. Furthermore, our recent work indicates that UFDs can retain substantial gas reservoirs prior to accretion by a massive host. We will create mock absorption line observations of our simulated UFDs at intermediate redshifts to establish or refute the connection between local UFDs as descendants of metal-poor damped Lyman alpha systems. The proposed simulation suite will thus be of critical importance to a wide range of ongoing HST programs designed to understand the gaseous, chemical, and dynamical evolution of the dwarf galaxies across cosmic time.
Proposal Category: AR
Scientific Category: Solar System
ID: 15031
Program Title: Disintegrating Comet 73P

Principal Investigator: David Jewitt

PI Institution: University of California - Los Angeles

Disintegration may be the leading cause of the demise of cometary nuclei yet is rarely observed and not well understood. We propose to use an amazing but largely unpublished archival dataset on comet 73P/Schwassmann-Wachmann 3 from HST in order to characterize the breakup of this body, focussing on components 73-B, 73-C and 73-G from GO 8699, 10625 and 10992. We will measure the number, sizes, velocities and (short-term) photometric variability of the fragments in 73-B and 73-G and derive the ejection speeds and times. A nucleus/coma convolution model will be used to extract the best estimates of fragment and nucleus size. The size distributions and integral masses will be compared to the parent body masses to estimate lifetimes. Lightcurves will be determined to the test the possibility that disintegration is due to rotational instability.
Active asteroids are a recently discovered solar system population in which diverse mechanisms generate unexpected asteroid mass loss. They are interesting scientifically because the mechanisms (rotational disruption, impact, volatile sublimation and others not yet identified) have not previously been observed in the asteroid belt. Our past work with HST has shown that high resolution is crucially important for understanding the properties of the active asteroids. Here, we seek 2 orbits of Target of Opportunity time so that we can quickly respond to a new active asteroid discovery, obtain and initial assessment of its properties and rates of change, and then make an evidence-based decision about the need for requesting more time in order to understand the object.
Planet-crossing asteroid (3200) Phaethon, source of the Geminid meteoroid stream, will pass close to Earth in December 2017. Observations with HST are proposed to image debris ejected from this object at 1 AU heliocentric distance, to estimate the ejection velocities as the Earth passes through the orbit plane, and to estimate the dust production rate for comparison with the rates needed to sustain the Geminid stream in steady-state. These measurements will help determine the mechanism behind the ejection of the Geminids, a long-standing puzzle. While the release of micron-sized particles (probably by thermal fracture) has been recorded at Phaethon’s perihelion (0.14 AU), mass loss has never been detected otherwise, raising the puzzle of the ejection mechanism and duration. The close approach (0.07 AU) on December 17 gives a once-in-a-lifetime opportunity to observe Phaethon at high sensitivity with a resolution of a few kilometers.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: SNAP
Scientific Category: Solar System
ID: 15344
Program Title: Centaurs and Activity Beyond the Water Sublimation Zone

Principal Investigator: David Jewitt

PI Institution: University of California - Los Angeles

Centaurs are icy objects in dynamical transition between the Kuiper belt, where they originate, and the Jupiter family comets. Water ice in inward drifting Centaurs should begin to sublimate measurably when their perihelion reaches the orbit of Jupiter (5 AU). Instead, a fraction of Centaurs become active (have a cometary appearance) even with perihelia at Saturn (10 AU). Of the many suggestions made for the origin of this distant activity, the current favorite and the one with the largest impact on cometary science is the crystallization of amorphous water ice. Amorphous ice is an excellent carrier of supervolatiles (e.g. CO, N2) which are released upon the exothermic transition to crystalline ice. If Centaur ice is amorphous, then so must be Kuiper belt ice, setting strong constraints on the internal temperature vs. time history of the Kuiper belt objects. If the crystallization hypothesis is correct, we should never find an active Centaur with a perihelion substantially beyond the so-called crystallization line at about 12 AU (because temperatures there are too low to trigger crystallization). We propose a simple search for distant activity in Centaurs with perihelia 15 to 20 AU, in which crystallization cannot occur, in order to challenge the crystallization hypothesis. The search is made possible by the tight and stable point spread function and sensitivity to near-nucleus coma of HST.
Type Ia supernovae (SN Ia) have enormous importance to cosmology and astrophysics, but their progenitors and explosion mechanisms are not understood in detail. Recently, observations and theoretical models have suggested that not all thermonuclear white-dwarf supernova explosions are normal SN Ia. In particular, type Iax supernovae (peculiar cousins to SN Ia), are thought to be exploding white dwarfs that are not completely disrupted, leaving behind a bound remnant. In deep and serendipitous HST pre-explosion data, we have discovered a luminous, blue progenitor system for the type Iax SN 2012Z in NGC 1309, which we interpret as a helium-star donor to the exploding white dwarf. HST observations of SN 2012Z in 2016, when the supernova light was expected to have faded away, still show a source at the location, as expected in our model where the pre-explosion flux was coming from the companion. However, the 2016 data also show a surprise: an excess flux compared to the progenitor system. Our proposed observations here will help unravel the mystery of that excess flux: is it from the bound ex-white dwarf remnant? Or is it from the shocked companion star that has been bombarded by supernova ejecta? Either of these possibilities would provide key new evidence as to the nature of these white dwarf supernovae.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15137
Program Title: Spectroscopically-Confirmed z > 6 Galaxies with Extremely Blue UV Slopes: Possible Pop III dominated targets for JWST spectroscopy

Principal Investigator: Linhua Jiang
PI Institution: Peking University

We propose to use HST/WFC3 to study 7 galaxies at z>6 with much bluer rest-frame UV continua than models of stellar populations and galaxy formation can accommodate. They were selected from a dedicated, large Subaru survey of bright spectroscopically-confirmed galaxies at z>6, and have extremely steep UV-slopes around beta=−3.

Such slopes have never been found in low-z galaxies, nor have they been predicted by cosmological simulations. Although recent HST observations found some extreme UV-slopes in photometrically-selected galaxies at z>6, this is controversial, since it could be caused by contamination and bias in photometrically-selected samples.

Our galaxies are bright (J=25-26.5 AB-mag) with secure spectroscopic redshifts, so their measurements of beta are NOT subject to these effects. They are the most promising candidates of truly extremely blue galaxies. Their uncertainties in beta are 0.3-0.5, mainly due to the short UV continuum baseline from previous HST data.

We propose to add critical WFC3 near-IR images over a larger wavelength baseline to significantly improve the beta measurements by reducing uncertainties to <0.2. The new images will conclusively confirm the existence of beta = -3 galaxies at z>6. Such ultra-blue beta-values would suggest the existence of very young stellar populations with extremely low metallicity and dust content, which are possibly Pop III star dominated. Their
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category:  GO  
Scientific Category: Planets and Planet Formation  
ID:  15310  
Program Title: A Survey for Molecular Hydrogen Emission Around Stars Forming Terrestrial Planets  
Principal Investigator: Christopher Johns-Krull  
PI Institution: Rice University

There is a discrepancy between the frequency of rocky planets in the inner AU known around Sun-like stars and the frequency of stars observed to be undergoing the collisions that form these planets. The discrepancy may indicate that rocky planets are less common than believed or that they form very differently than we have imagined, producing little or no debris signature. A third, less dramatic possibility is that planet-forming systems retain a tenuous reservoir of gas that whisks away the warm dust (debris) produced by planet-forming collisions. Over the past decade, it has been recognized that fluorescent FUV molecular hydrogen emission is an excellent tracer of gas in the planet forming regions of disks around young stars. Therefore, we will use HST COS with the G130M grating to survey the FUV spectrum between 1140 - 1450 Ang for molecular hydrogen emission from a sample of 30 stars in the 11 Myr old Upper Scorpion star forming region. These data will test whether small amounts of disk gas remove the debris from planet forming collisions, or whether rocky planet formation possibly proceeds much differently than currently thought.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: SNAP  
Scientific Category: Galaxies and the IGM  
ID: 15279

Program Title: Unveiling Quasar Fueling through a Public Snapshot Survey of Quasar Host Environments

Principal Investigator: Sean Johnson  
PI Institution: Princeton University

Feedback from quasars is thought to play a vital role in galaxy evolution, but the relationship between quasars and the halo gas that fuels star-formation on long timescales is not well constrained. Recent observations of the content of quasar host halos have found unusually high covering fractions of cool gas observed in absorption in background quasar spectra. The cool halo gas is strongly correlated with quasar luminosity and exceeds what is observed around non-AGN galaxies by a factor of two. Together, these observations provide compelling evidence for a connection between AGN activity and halo gas on 20-200 kpc scales. The high covering fraction and correlation with quasar luminosity may be the result of debris from the galaxy mergers thought to trigger luminous quasars or the halo gas of satellites in gas-rich groups amenable to quasar feeding. If this is the case, then the cool gas observed in absorption will be correlated with signatures of recent galaxy interactions in the quasar host or satellites close to the background sightline. Here, we propose a snapshot imaging survey of z<1 quasars with available constraints on halo gas content to examine a possible correlation between cool halo gas and galaxy interaction signatures. Galaxy morphologies and faint tidal features at z~1 can only be observed with the high resolution imaging capabilities of HST due to the substantial flux in extended wings of AO point-spread functions. The images will be of significant archival value for studying the galaxy environments of quasars and for constraining gas flow models with multi-sightline halo gas studies of galaxies at lower redshift than the foreground & background quasars.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Massive Black Holes And Their Host Galaxies
ID: 15280
Program Title: Spatially resolved rest-UV spectroscopy of a prototypical quasar driven superwind at low-z

Principal Investigator: Sean Johnson
PI Institution: Princeton University

Powerful galaxy-wide winds launched by quasars are thought to be a common evolutionary phase of massive galaxies, but observations of this phenomena are scarce. We have conducted a multi-wavelength observational campaign for J1356+1026, a poster-child obscured quasar driving a superwind at z=0.123. J1356+1026 is driving a nuclear molecular outflow and an extended ionized outflow observed as an [OIII] emitting bubble at \sim 10 kpc that is spatially coincident with soft X-ray emission. Quasar-driven winds carry material at a wide range of densities and temperatures making it difficult to measure their energetics and the dominant phases are unknown. Here we propose spatially resolved rest-UV spectroscopy by acquiring circum-nuclear absorption spectra of J1356+1026 and emission spectra of its off-nucleus bubble using COS+G140L. The circum-nuclear spectrum will provide measurements of the outflow velocity through blueshifted absorption while the off-nuclear spectrum of the bubble will measure the ionization state and mechanisms of the outflow through powerful UV diagnostic lines. Together, these spectra will enable a more complete mass, energy and momentum accounting of a spatially resolved quasar driven superwind for the first time. Furthermore, detection of shocked gas through OVI emission will enable us to infer properties of the enigmatic volume-filling, low density component of the wind. To our knowledge, this will be the first spatially resolved rest UV spectroscopy of a quasar wind and the proposed observations will serve as a pilot to guide future HST proposals.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Cosmology  
ID: 15298  
Program Title: The first high resolution image of coronal gas in a starbursting cool core cluster  
Principal Investigator: Sean Johnson  
PI Institution: Princeton University

Galaxy clusters represent a unique laboratory for directly observing gas cooling and feedback due to their high masses and correspondingly high gas densities and temperatures. Cooling of X-ray gas observed in ~1/3 of clusters, known as cool-core clusters, should fuel star formation at prodigious rates, but such high levels of star formation are rarely observed. Feedback from active galactic nuclei (AGN) is a leading explanation for the lack of star formation in most cool clusters, and AGN power is sufficient to offset gas cooling on average. Nevertheless, some cool core clusters exhibit massive starbursts indicating that our understanding of cooling and feedback is incomplete. Observations of ~10^5 K coronal gas in cool core clusters through OVI emission offers a sensitive means of testing our understanding of cooling and feedback because OVI emission is a dominant coolant and sensitive tracer of shocked gas. Recently, Hayes et al. 2016 demonstrated that synthetic narrow-band imaging of OVI emission is possible through subtraction of long-pass filters with the ACS+SBC for targets at z=0.23-0.29. Here, we propose to use this exciting new technique to directly image coronal OVI emitting gas at high resolution in Abell 1835, a prototypical starbursting cool-core cluster at z=0.252. Abell 1835 hosts a strong cooling core, massive starburst, radio AGN, and at z=0.252, it offers a unique opportunity to directly image OVI at hi-res in the UV with ACS+SBC. With just 15 orbits of ACS+SBC imaging, the proposed observations will complete the existing rich multi-wavelength dataset available for Abell 1835 to provide new insights into cooling and feedback in clusters.
Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15077
Program Title: Accurate Emission Line Diagnostics at High Redshift

Principal Investigator: Tucker Jones
PI Institution: University of California - Davis

How do the physical conditions of high redshift galaxies differ from those seen locally? Spectroscopic surveys have invested hundreds of nights of 8- and 10-meter telescope time as well as hundreds of Hubble orbits to study evolution in the galaxy population at redshifts z~0.5-4 using rest-frame optical strong emission line diagnostics. These surveys reveal evolution in the gas excitation with redshift but the physical cause is not yet understood. Consequently there are large systematic errors in derived quantities such as metallicity.

We have used direct measurements of gas density, temperature, and metallicity in a unique sample at z=0.8 to determine reliable diagnostics for high redshift galaxies. Our measurements suggest that offsets in emission line ratios at high redshift are primarily caused by high N/O abundance ratios. However, our ground-based data cannot rule out other interpretations. Spatially resolved Hubble grism spectra are needed to distinguish between the remaining plausible causes such as active nuclei, shocks, diffuse ionized gas emission, and HII regions with escaping ionizing flux. Identifying the physical origin of evolving excitation will allow us to build the necessary foundation for accurate measurements of metallicity and other properties of high redshift galaxies. Only then can we exploit the wealth of data from current surveys and near-future JWST spectroscopy to understand how galaxies evolve over time.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Planets and Planet Formation
ID: 15138
Program Title: The Atmosphere of an Extremely Low Density Super-Earth Mass Planet

Principal Investigator: Daniel Jontof-Hutter

PI Institution: University of the Pacific

Kepler-79 d provides a unique opportunity to study the atmosphere of a low-mass low density planet among compact multi-transiting systems. It has the largest estimated atmospheric scale-height for a planet in a known compact system of four or more transiting exoplanets and has the highest expected atmospheric annulus depth for any exoplanet unobserved by HST. Its extremely low density, and its low mass places it among a small number of exoplanets that challenge atmospheric mass loss models. Other planets of similarly low density are likely young in age and may still be cooling and contracting. With an age of ~3.4 Gyr, however, Kepler-79 d is unlikely to be contracting and is the best candidate for atmospheric retrieval among low density planets in compact formation. Whether such compact multi-transiting systems formed in situ or beyond the snow-line before migrating to within 1AU is the subject of a high profile debate in planet formation theory, motivating the search for atmospheric water. Kepler-79 d occupies a unique space in temperature, surface gravity and stellar type which will provide an important constraint on the formation of clouds and hazes, although a cloud-free atmosphere is expected for a wide range of compositions.
Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15237
Program Title: Resolving the discrepancy in the mass determination from the gravitational redshift of Sirius B

Principal Investigator: Simon Joyce
PI Institution: University of Leicester

White dwarfs (WDs) are the remnants of stars with initial masses less than 8Msol. Many studies make use of WDs as tools to help in other areas of astronomy, for example, to determine the ages of stellar populations. The white dwarf mass-radius relation is a foundation of many studies which are only possible because the WD mass-radius relation allows us to calculate these parameters when they cannot be independently observed.

Despite its well accepted theoretical basis, the white dwarf mass-radius relation has been difficult to test observationally due to the difficulty of making observations of sufficient precision. We propose STIS observations of Sirius B, which is the nearest WD, to obtain the spectrum of the H alpha absorption line which can be used to measure the mass of the WD through the gravitational redshift method. Previous HST observations of Sirius B have allowed us to measure the mass to a high level of precision. However this has uncovered a significant unexplained discrepancy between the mass calculated using the gravitational redshift method and the astrometrically determined mass. Our aim is to resolve this discrepancy by using the traditional method of measuring the gravitational red shift of the WD relative to the luminous primary, in this case Sirius A. We will measure the wavelengths of the H-alpha lines in both Sirius B and A using the same STIS G750M grating during the same visit. This will remove many of the systematic uncertainties affecting previous observations. This will either allow us to confirm the validity of this fundamental method and the mass-radius relationship, or it may uncover a gap in our understanding which needs to be addressed.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

<table>
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<tr>
<th>Proposal Category:</th>
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<tr>
<td>Scientific Category:</td>
<td>Planets and Planet Formation</td>
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<tr>
<td>ID:</td>
<td>15172</td>
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<tr>
<td>Program Title:</td>
<td>Validating early stellar encounters as the cause of dynamically hot planetary systems</td>
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<tr>
<td>Principal Investigator:</td>
<td>Paul Kalas</td>
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<td>PI Institution:</td>
<td>University of California - Berkeley</td>
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One of the key questions concerning exoplanetary systems is why some are dynamically cold, such as TRAPPIST-1, whereas others are dynamically hot, with highly eccentric planets and/or perturbed debris disks. Dynamical theory describes a variety of plausible mechanisms, but few can be empirically tested since the critical dynamical evolution that sets the final planetary architecture is short-lived. One rare system available for testing dynamical upheaval scenarios is the 400 Myr-old Fomalhaut system. In Cycle 22 we coronagraphically studied Fomalhaut C, which is a wide M-dwarf companion to Fomalhaut A, in order to test our prediction that the unresolved, Herschel-detected debris disk around Fomalhaut C may be highly perturbed because of a recent close interaction with Fomalhaut A. Using HST/STIS we discovered a highly asymmetric feature extending northward of Fomalhaut C by 3'' that resembles our model of a dynamically hot disk. However, it may be a background galaxy and the definitive test of its physical relationship to Fomalhaut C is to demonstrate common proper motion. Using Keck adaptive optics follow-up observations in J band, we did not detect the feature, and hence follow-up HST observations are the only way to test for common proper motion. Here we request a very small program to revisit Fomalhaut C with STIS in order to validate the initial discovery as a debris disk (1'' proper motion between HST epochs). The astrophysical significance is demonstrating that the Fomalhaut system is a valuable case for studying dynamical upheavals via stellar encounters that are inferred to occur in the evolution of many other planetary systems.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Stellar Populations  
ID: 15173  
Program Title: Linking Dynamical and Stellar Evolution in the Metal-Poor Globular Cluster M92

Principal Investigator: Jason Kalirai  
PI Institution: Space Telescope Science Institute

We propose a 5 orbit HST program to acquire UV imaging at the center of the ancient, metal-poor globular cluster NGC 6341 (M92). Our program is designed to achieve two science goals with a single data set, 1.) to directly measure the diffusion of stars through the massive cluster's core, 2.) to pinpoint the phase of post main-sequence evolution at which [Fe/H] = -2.3 stars lose their mass. Our novel technique will achieve these goals by using the full power of WFC3's exquisite UV sensitivity at <0.3 microns combined with its high spatial resolution. We will uncover ~1000 newly-formed white dwarfs in the center of M92 and track how their spatial distribution changes as they get "older" on the cooling sequence. Having just experienced significant mass loss, the youngest remnants with ages <10s of Myr will still be moving slowly like their 0.8 Msun progenitors, whereas the "older" remnants with t_cool > 100s Myr will be fully relaxed. Using the methodology we developed and successfully applied to 47 Tuc (Heyl et al. 2015a; 2015b), we will "watch" this dynamical evolution to measure the diffusion coefficient due to gravitational relaxation in the cluster's core and the past timing of stellar mass loss that was responsible for the current cluster mass segregation profile. M92 is the ideal target for this study as it complements our existing study of the relatively metal-rich cluster 47 Tuc; it has an extremely low metallicity of [Fe/H] = -2.3, very low foreground reddening (E(B-V) = 0.02), moderate concentration index, and a theoretically-expected relaxation timescale in its core of 90 Myr, which nicely splits the young and old white dwarfs that can be observed with Hubble.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15345
Program Title: Unveiling Curious Infrared Transients with HST and JWST

Principal Investigator: Mansi Kasliwal

PI Institution: California Institute of Technology

Our Spitzer InfraRed Intensive Transients Survey (SPIRITS) has discovered a mysterious class of IR transients that are so red that they lack optical counterparts to deep limits. We dub these events eSpecially Red Intermediate-luminosity Transient Events (SPRITEs). The nature of SPRITEs is unknown and progress on deciphering the explosion physics depends on follow-up observations with the Hubble Space Telescope (HST) and the James Webb Space Telescope (JWST). Multiple physical origins have been proposed including the birth of a massive binary, stellar merger, and electron capture supernova. While the JWST observations will investigate the dusty circumstellar environment of SPRITEs, our proposed deep near-IR imaging with HST will probe the "blue" side of the SPRITE spectrum to measure the magnitude of obscuration. Both JWST and HST results are critical for disentangling their various proposed origins.

JWST follow-up spectroscopy and imaging of three SPRITEs will be performed as Targets of Opportunity (ToO) in our Guaranteed Time Observations program during JWST Cycle 1. Here, we propose coordinated HST/WFC3IR imaging observations with the F110W and F160W filters to complete the full IR SED of the JWST-targeted SPRITEs. We request 3 HST pre-allocated Cycle 26 orbits (1 per each JWST ToO) as non-disruptive ToO observations.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15346
Program Title: Verifying a candidate counterpart to gravitational waves

Principal Investigator: Mansi Kasliwal

PI Institution: California Institute of Technology

With advances in sensitivity of gravitational wave interferometers, the direct detection of neutron star mergers should be imminent. Identification of an electromagnetic counterpart would enable a wealth of astrophysics and answer the long-standing question of whether neutron star mergers are the missing cosmic mines of heavy elements synthesized by the r-process. We will be searching for a fast-fading optical counterpart with the new Zwicky Transient Facility at Palomar Observatory. Here, we propose to use HST/WFC3 to look for infrared emission from a single, most-promising candidate optical counterpart. The infrared emission would serve as a direct diagnostic of the radioactive decay of heavy elements.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions) 

Proposal Category: GO  
Scientific Category: Solar System  
ID: 15108  
Program Title: Enabling physical study of the Kuiper belt via HST tracking observations of close fly-by targets for the New Horizons spacecraft.  
Principal Investigator: J. Kavelaars  
PI Institution: National Research Council of Canada  

In winter 2018 / 2019, the New Horizons spacecraft will make close (~0.1 au) fly-bys of two small outer solar system bodies (2014 OS393 and 2014PN70). These two objects are among the three that we discovered during our HST based search for a New Horizons Kuiper belt encounter target (now selected; 2014 MU69). These will be our closest fly-by observations, among the nearly dozen TNOs that we will observed from NH. They will appear the brightest as seen from NH, be the best resolved (about 10x higher resolution than HST) and will provide the largest science impact among our flyby targets. We will measure their phase curves, their rotational light curves and search for rings and companion objects.  

Although the orbits of these two TNOs are among some of the best known they are not yet well enough constrained to enable the science. Due to the closeness of the fly-by we must further refine our knowledge of their orbits so as to reduce the uncertainty in the projected sky-plane when viewed from New Horizons.  

We are requesting 5 HST orbits to further secure the ephemerides of these objects and enable this high-impact science return from the New Horizons Kuiper Extended Mission.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: AR  
Scientific Category: Galaxies and the IGM  
ID: 15032  
Program Title: Filling the Void: A Comprehensive Survey of the Intergalactic Medium at z~1 Using STIS/COS Archival Spectra  
Principal Investigator: Vikram Khaire  
PI Institution: IUCAA

There exists a large void in our understanding of the intergalactic medium (IGM) at z=0.5-1.5, spanning a significant cosmic time of 4 Gyr. This hole resulted from a paucity of near-UV QSO spectra, which were historically very expensive to obtain. However, with the advent of COS and the HST UV initiative, sufficient STIS/COS NUV spectra have finally become available, enabling the first statistical analyses. We propose a comprehensive study of the z~1 IGM using the Ly-alpha forest of 26 archival QSO spectra. This analysis will: (1) measure the distribution of HI absorbers to several percent precision down to log NHI < 13 to test our model of the IGM, and determine the extragalactic UV background (UVB) at that epoch; (2) measure the Ly-alpha forest power spectrum to ~12%, providing another precision test of LCDM and our theory of the IGM; (3) measure the thermal state of the IGM, which reflects the balance of heating (photoheating, HI/Hell reionization) and cooling (Hubble expansion) of cosmic baryons, and directly verify the predicted cooldown of IGM gas after reionization for the first time; (4) generate high-quality reductions, coadds, and continuum fits that will be released to the public to enable other science cases. These results, along with our state-of-the-art hydrodynamical simulations, and theoretical models of the UVB, will fill the 4 Gyr hole in our understanding of the IGM. When combined with existing HST and ground-based data from lower and higher z, they will lead to a complete, empirical description of the IGM from HI reionization to the present, spanning more than 10 Gyr of cosmic history, adding substantially to Hubble's legacy of discovery on the IGM.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: AR
Scientific Category: Galaxies and the IGM
ID: 15033
Program Title: A COS archival survey for proximate absorbers at z−z(em) in AGN spectra at z<0.4

Principal Investigator: Tae-Sun Kim
PI Institution: University of Wisconsin - Madison

We propose to conduct the first systematic survey of proximate absorbers within 5000 km/sec of AGN emission redshifts, using ~330 spectra of Seyferts and QSOs at z(em)<0.4 in the COS/FUSE archives. These absorbers are produced by 1) intrinsic weak AGN outflows, 2) the interstellar medium (ISM) or circumgalactic medium (CGM) of host galaxies or 3) the intergalactic medium (IGM) around AGNs. Weak outflows are generally considered to be energetically unimportant for feedbacks, but still a sensitive diagnostic of the ionization structure and kinematics of gas near the AGN engine. Together with weak outflows, proximate ISM/CGM/IGM absorbers provide the physical conditions of gas in the AGN environment. At low redshifts, proximate absorbers have been relatively less studied, as they require high-quality data and reliable physical models to interpret. Our immediate goal is 1) to classify proximate absorbers based on HI, metals and evidence of AGN partial coverage, 2) to quantify their detection rate and correlate between absorbers and intrinsic AGN properties to test the AGN unified schemes, 3) to derive absorber physical conditions from CLOUDY photionization modeling, 4) to constrain the importance of weak outflows to AGN feedback by estimating their mass outflow rates, and 5) to compare low-z and high-z proximate absorbers to study their evolution over cosmic time.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15311
Program Title: Confirming the Formation of a Black Hole

Principal Investigator: Chris Kochanek
PI Institution: The Ohio State University

There are good observational and theoretical reasons to believe that 10-30% of the core-collapse supernovae of massive stars lead to the formation of black holes without a supernova explosion. We have been carrying out the first observational search for such failed supernovae using the Large Binocular Telescope. From seven years of LBT survey data we have one good candidate, NGC6946-BH1. HST observations in 2015 found a possible near-IR counterpart to the candidate that is significantly less luminous than the progenitor. If the source is related to BH1, this could be either emission from late time accretion luminosity or obscuration of a surviving star by an expanding shell of dust too cool to be detected in our warm SST observations. New HST WFC3/IR observations of the source should find that the source is either fainter (late-time accretion) or brighter (obscured by an expanding shell). This is critical information to inform proposals for JWST observations to search for colder dust.
Tidal disruption events (TDE), where supermassive black holes destroy stars to produce accretion flares, are of great current observational and theoretical interest. Here we propose a seven epoch STIS UV spectroscopic "movie" of a UV bright TDE spread over the first ~90 days after a rapid TOO trigger. The roughly 15 day cadence is comparable to the expected and observed time scales for kinematic changes in the optical and UV emission and absorption lines. We will measure the evolution of UV absorption and emission lines from elements (e.g., C, N, Si) and ionization states/potentials not seen in optical spectra of TDEs, which should help to illuminate their dynamical evolution. In some cases, the debris from the stellar cores should have significantly enhanced [N/C] abundances due to the CNO cycle, so UV spectra can provide a means of differentiating debris from the core and the envelope of the disrupted star. Optically-selected TDEs are energetically dominated by their UV emission, making it the wavelength range most needed to understand these fascinating transients.
Proposal Category: GO
Scientific Category: Massive Black Holes And Their Host Galaxies
ID: 15281
Program Title: Characterizing Mass Outflows in Palomar Green Quasars: evidence for AGN feedback?

Principal Investigator: Steven Kraemer
PI Institution: Catholic University of America

The correlation between the masses of galaxy bulges and the super-massive black holes (BH) at their gravitational centers suggests that they co-evolve. The process thought to regulate bulge/BH growth is "AGN feedback", either in the form of radiation-driven ("quasar mode") or mechanically driven (e.g., "radio mode") outflows. Our recent HST/ACS/STIS study of QSO2s has, indeed, revealed outflows, but they do not extend beyond ~ 1.5 kpc, which calls into question their relevance to feedback processes. However, the morphologies of these objects suggest that they may be in an early state of activity, before the outflows can clear the bulges. To explore whether large-scale outflows are present, we propose to extend our study to the 7 [O III] brightest, radio quiet, PG QSO1s. Previous HST/WFPC2 images reveal that these targets possess extended emission-line regions. Therefore, we propose to obtain HST/ACS images and STIS long-slit spectra of these targets with which we will measure and model the extended emission-line gas kinematics, probe the dynamics of the gas, and, ultimately, determine whether AGN-driven outflows exist in these QSOs. Ground-based observations lack the sensitivity to probe the extended emission-line gas, hence this study can only be accomplished with HST. These results will have profound implications towards our understanding of AGN feedback.
Proposition Category: GO
Scientific Category: Stellar Physics
ID: 15238
Program Title: The IMF to Planetary Masses Across the Milky Way

Principal Investigator: Adam Kraus
PI Institution: University of Texas at Austin

Observations have now verified the long-held theoretical assumption that the IMF extends into the planetary mass regime with the discovery of a small number of brown dwarfs as light as 5 MJup or below. Planetary-mass BDs are an extreme outcome of star formation, posing a strong test of the physics and conditions (e.g., gas density, turbulence, and temperature). There are strong theoretical arguments that the IMF should vary if these conditions change with environment, but this possibility remains untested since planetary-mass BDs have only been found in sparse associations. We propose to exploit a new fast-mosaic technique with WFC3/IR to map five benchmark star-forming regions that are more massive than any in the solar neighborhood; this survey will extend our census down the IMF into the planetary mass regime (3-5 MJup) and across environment from sparse associations (N=200) to massive clusters (N=50,000). We will map these clusters with three filters (F110W, F139M, F160W), exploiting water absorption in F139M to distinguish cool cluster members from reddened early-type field interlopers. In addition to identifying the bottom half of the IMF (0.5 Msun to 5 MJup) and measuring its slope and lowest extreme, we also will identify thousands of brown dwarfs (>1000 of which will fall below 15 MJup) for highly multiplexed JWST spectroscopy. Given the density of these clusters and extreme sensitivity but high overheads of JWST, multiplexed observations of dense cluster populations will yield the vast majority of spectra for free-floating exoplanet analogs over the next decade.
Proposal Category: GO
Scientific Category: Planets and Planet Formation
ID: 15109
Program Title: Caught Red-Handed: A Novel Search for the Culprit Behind Thermal Inversions in Exoplanet Atmospheres

Principal Investigator: Laura Kreidberg
PI Institution: Harvard University

Thermal inversions have been one of the mostly hotly debated topics in exoplanet atmospheres over the last decade. Recent observations show conclusively that thermal inversions do exist for some of the most highly irradiated planets. The likeliest culprit for the inversions is strong absorption by titanium and vanadium oxide (TiO/VO) gas, which heats the upper atmosphere. However, TiO/VO have never been detected, despite many attempts. It is possible that these efforts failed because they focused on planets that were too cool, or were foiled by clouds and haze.

We propose a novel search for TiO in the atmosphere of WASP-33b, a planet with a known thermal inversion (Haynes et al. 2015). We will measure the planet's thermal emission spectrum with the WFC3/G102 grism, where TiO is expected to have strong spectral features. This is the first proposed use of this grism for exoplanet emission spectroscopy. WASP-33b has the single highest signal-to-noise in thermal emission of any exoplanet known, and with one eclipse observation we will be sensitive to temperature differences in the upper atmosphere of <50 Kelvin. If TiO is present, we will detect it at high confidence (>10 sigma) and definitively settle the thermal inversion debate.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Planets and Planet Formation
ID: 15110
Program Title: A Study of the UV Environment for Three Small Planets Transiting a Nearby M-Dwarf

Principal Investigator: Laura Kreidberg
PI Institution: Harvard University

We propose to measure the ultraviolet (UV) spectrum of the M-dwarf K2-3. This nearby system hosts three transiting super-Earths, including one that is a possible candidate to host life. All three planets are excellent targets for atmospheric study, and raise the exciting prospect of comparative planetology with the newly discovered seven planet TRAPPIST-1 system.

However, M-dwarfs are bright and active in the UV, which can push their planets' atmospheres out of chemical equilibrium and drive atmospheric mass loss. Some of the most strongly affected molecules, including water, methane, and ozone, are key diagnostics of the planets' formation history, habitability, and even inhabitation. Our measurement of K2-3's UV spectrum will allow us to characterize the impact of photochemistry and mass loss on the planets' atmospheres, thus providing an essential foundation for future investigations of this benchmark system.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Massive Black Holes And Their Host Galaxies  
ID: 15239  
Program Title: Searching for the UV counterpart of the extraordinary X-ray UFO in the NLSy1 IRAS17020+4544  

Principal Investigator: Yair Krongold  
PI Institution: Universidad Nacional Autonoma de Mexico (UNAM)

We recently reported the first unambiguous discovery in high resolution X-ray data of an ultra fast outflow (UFO) with velocity ~1c. This wind, in Narrow Line Seyfert 1 galaxy IRAS17020+4544, represents so far the most compelling detection of an UFO, with many different absorption lines that give rise to very high significance detections. The charge states that form the wind clearly indicate a large range of ionization states in the gas, and significant absorption by Ly alpha, C IV, Si IV and N V (among other ions) is expected in the UV band. The goal of our proposed program is to observe an characterize the best X-ray detected UFO in the UV. These observations are crucial to study in great detail the UFO phenomenon, and understand its nature and its relation to the narrow absorption line low velocity systems. Only through detection of Ly alpha absorption in the UV data, measurements of the metallicity of these winds will be possible. The proposed program will help guide new theoretical models of UFOs origins, beyond the simple actual picture that predicts only very high ionization Fe absorption. UV data are required to understand the wind nature and launching mechanism (whether due to radiation pressure via line or continuum opacity, or magnetic forces). Fully characterizing the wind properties will put stronger constraints in the mass outflow and kinetic outflow rates of these systems, as well as in their geometry. Such estimates will give a much clearer picture of UFOs feedback potential, and will provide clues on the feedback mode in action (e.g. energy conserving vs. momentum conserving).
Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15240
Program Title: Caught in the Act: UV spectroscopy of the ejecta-companion collision from a type Ia supernova

Principal Investigator: Shrinivas Kulkarni
PI Institution: California Institute of Technology

There is now significant observational evidence for both of the leading models proposed to explain the origin of type Ia supernovae (SNe). While the majority of SNe Ia likely come from the merger of two white dwarf (WD) stars (known as the double degenerate model), a significant fraction are the result of a WD accreting mass from the hydrogen envelope of a binary companion (known as the single degenerate model). Eventually, as the accreting WD approaches the Chandrasekhar limit, the onset of unstable burning occurs ultimately leading to a thermonuclear explosion. With observational evidence for both channels firmly in place, future efforts to better understand the progenitors of SNe Ia will require detailed studies of individual systems.

A fundamental expectation of the single degenerate model is that the collision of the blast wave with the donor star will produce a unique signature — a bright and rapidly declining UV pulse. This UV signal has only been previously observed in a single SN. Here, we propose to undertake STIS UV spectroscopy of one infant type Ia SN with similarly strong UV emission. The spectra will provide unique and detailed insight into the ejecta-companion interaction while also probing the chemical abundance of the outermost layers of the SN ejecta. The ejecta-companion signature is only visible UV, and HST/STIS is the only instrument capable of obtaining the spectra that are needed as a detailed probe of the interaction physics.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Stellar Populations
ID: 15078
Program Title: Initial conditions of multiple populations in the dynamically most pristine globular cluster, NGC 2419

Principal Investigator: Soeren Larsen
PI Institution: Radboud Universiteit Nijmegen

The remote globular cluster (GC) NGC 2419 is unique in the Milky Way by having a half-mass relaxation time that exceeds the age of the Universe. This makes it an ideal target for studying the initial spatial distributions of sub-populations within the cluster. Most scenarios for the origin of multiple populations in GCs predict that enriched ("2nd-generation") stars should have a more centrally concentrated radial distribution than the pristine stars. This has indeed been found by a number of studies for the outer regions of GCs, although these (mostly ground-based) studies generally did not probe the center. We have recently found the opposite trend from HST observations of the central regions of the GC M15, where the enriched stars are the least centrally concentrated. This suggests a more complex situation than implied by most formation scenarios. Here we propose to determine the radial distributions of sub-populations in the central regions of NGC 2419 and determine whether it formed with a more centrally concentrated pristine population. This unique, dynamically pristine environment is free of the dynamical effects (such as orbital mixing and mass segregation) that may have modified the spatial distributions in other clusters, and will thus directly reflect the initial conditions. We will use F336W and F343N data to unambiguously separate pristine and enriched stars, based on their N abundances (that are enhanced by about 2 dex in enriched stars). By combining these data with archival observations at longer wavelengths, we will also determine the He abundances of the different populations.
**Proposal Category:** GO  
**Scientific Category:** Galaxies and the IGM  
**ID:** 15241  
**Program Title:** Clumpy Star Formation in Local LIRGS  

**Principal Investigator:** Kirsten Larson  
**PI Institution:** California Institute of Technology  

Near IR PaBeta and PaAlpha imaging of Luminous Infrared Galaxies (LIRGs) have revealed that local LIRGs host many luminous clumpy star forming regions. These star forming regions range in SFR from (.001 to 10 Msun/yr) and span the range from local galaxies to those found at high redshift (1 < z < 3); thus, bridging the gap between the local and the high-z universe. Star-formation in high-z galaxies is often concentrated in luminous star-forming `clumps' that are significantly larger and more luminous than those observed in normal galaxies in the local universe. These large clumps of star-formation are thought to be the product of high gas fractions in turbulent disks. We propose to obtain narrow-band PaBeta imaging of 20 local LIRGs with high molecular gas fractions (MGF > 20%) to study the key physical properties of star forming clumps in these high gas environments. We will measure the sizes, luminosities, and energy input of clumps of young massive stars that are currently being formed. The goals of this project are: (1) to investigate the role of star formation rate, MGF, and galaxy interactions on the clump luminosity function (2) to test if higher MGF LIRGs produce star forming clumps with higher SFR densities and (3) directly compare our results star forming clumps in local normal star forming galaxies, high redshift galaxies observed at the highest spatial resolution using gravitational lensing, and state of the art galaxy simulations.
Proposal Category: AR
Scientific Category: Massive Black Holes And Their Host Galaxies
ID: 15034

Program Title: Observing AGN Feedback Down-the-Barrel Using Associated Absorbers at z <~ 1.5

Principal Investigator: Marie Wingyee Lau

PI Institution: University of California - Santa Cruz

Observations have shown a high incidence of highly ionized absorbers within several thousand km/s of the emission redshift of AGNs, which are termed narrow associated absorption line systems (NAALs). Observations of gas surrounding quasar-host galaxies in comparison to NAALs on circumgalactic scales have found anisotropic ionizing radiation, which may translate to anisotropy in AGN feedback. While z >~ 2 NAALs have been extensively surveyed in optical datasets, analyses at z <~ 1.5 have been limited to small samples with underutilized observational constraints.

We propose an exhaustive, archival search of HI, CIV, NV, OVI narrow absorbers at velocity separation > -10000 km/s from the systemic redshift in z <~ 1.5 AGNs. Our goal is to examine their physical conditions and statistical properties, using a sample of unprecedented size. We will assess their kinematics, chemical abundances, ionization states, and distances to the host AGN. We will assess correlation patterns among properties of NAALs and AGN luminosity. We will compare the line-of-sight circumgalactic medium to studies of circumgalactic medium transverse to the AGN to assess AGN feedback. In contrast to the high-z universe, AGNs at z <~ 1.5 have more precisely measured systemic redshifts, which will enable us to search for signs of coherent outflows and infalling gas, and separately analyze possible inflows for the first time. Moreover, the lower IGM opacity will allow much higher sensitivity to the far and extreme UV diagnostics.

We will release a database of UV spectra cross-matched with optical spectra of the same AGNs, with improved continuum fits and identifications of associated absorption lines.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Planets and Planet Formation  
ID: 15139  
Program Title: Metals from deep atmosphere to exosphere in hot-Jupiters

Principal Investigator: Alain Lecavelier des  
PI Institution: CNRS, Institut d’Astrophysique de Paris

With STIS/UV observations we detected magnesium atoms at high altitude in the atmosphere of the hot-Jupiter HD209458b, probing lower regions in the atmosphere than previously done with Lyman-alpha observations. Here we propose to search for magnesium and other heavy species in escaping atmospheres of 2 giant planets orbiting hot A and F-type stars. The proposed observations will provide unprecedented information on the physical conditions (velocity, temperature, and density) in the upper atmosphere of these two hot-Jupiters. Targets have been selected for the expected high significance level of the atmospheric detections (>10 sigma). These exoplanets present favorable configuration for upper atmosphere observations because of the combination of high escape rates and large spatial extensions of the magnesium clouds surrounding them, due to the large energetic radiations from the hosting A and F-type stars. The atmospheric signatures of the magnesium and other metals are therefore expected to be easily detectable.

Moreover, the two selected exoplanets have highly different equilibrium temperatures, below and above the MgSiO3 condensation temperature. Consequently, because the metals observed in the escaping flow originate from deeper in the atmosphere where haze can condensate, the observations will constrain the physical processes taking place in the clouds that cannot be observed directly.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15313
Program Title: The AGN Impact on the Circumgalactic Medium of Cen A

Principal Investigator: Nicolas Lehner
PI Institution: University of Notre Dame

There seems to be broad agreement that feedback from AGN plays a critical role in transforming massive star forming galaxies to quiescent ones and keeping them quenched thereafter. Through the emission of copious amounts of radiation emitted in the active QSO/AGN phase and the deposition of thermal and mechanical energy on scales of hundreds of kpc during the radio phase, AGN feedback shifts the temperatures and ionization states of the gas in the circumgalactic medium (CGM) of these galaxies to higher energies, suppressing cooling that might otherwise provide fuel for new star formation. We propose to observe absorption lines from the CGM of the nearby, very well-studied giant radio-lobe galaxy Cen A to search directly for the signal of AGN feedback impacting the CGM of a galaxy. We will target 4 background QSOs projected 270-340 kpc from the galaxy at a range of azimuthal angles relative to the 300 kpc-long jets and 1 "control" sight line well away from the jets. These spectra will provide probes of the ionization balance and kinematic structure of the cool/warm CGM. This will be the first attempt to dissect the cool/warm gas in a CGM undergoing interactions with an active AGN.
A significant fraction of quasars exhibits blueshifted broad absorption lines (BALs) in their rest-UV spectra, indicating powerful outflows emerging from the central engine. These outflows may remove angular momentum to enable black hole growth, enrich the intergalactic medium with metals, and trigger quenching of star formation in galaxies. Despite years of study, the physical conditions of the outflowing gas are poorly understood. The handful of objects that have been subjected to detailed analysis are atypical and characterized by relatively narrow lines where blending is unimportant. However, investigating more powerful BAL quasars will give us better insight into the types of outflows much more likely to impact galaxy evolution.

SimBAL is a novel spectral synthesis fitting method for BAL quasars that uses Bayesian model calibration to compare synthetic to observed spectra. With the model inputs of ionization parameter, column density, and covering fraction specified, the gas properties giving rise to the BAL features can be determined. We propose to apply SimBAL to archival spectra of a sample of 14 luminous BAL quasars to
Proposal Category: AR
Scientific Category: Galaxies and the IGM
ID: 15036
Program Title: A New Probe of Dust Attenuation in Star-Forming Galaxies

Principal Investigator: Claus Leitherer

PI Institution: Space Telescope Science Institute

We propose to develop, calibrate and test a new technique to measure dust attenuation in star-forming galaxies. The technique utilizes the strong stellar-wind emission lines in Wolf-Rayet stars, which are routinely observed in galaxy spectra locally and up to redshift 3. The He II 1640 and 4686 features are recombination lines whose intrinsic ratio is almost exclusively determined by atomic physics. Therefore it can serve as a stellar dust probe in the same way as the nebular hydrogen-line ratio can be used to measure the reddening of the gas phase. Archival spectra of Wolf-Rayet stars will be analyzed to calibrate the method, and panchromatic FOS and STIS spectra of nearby star-forming galaxies will be used as a first application. The new technique allows us to study stellar and nebular attenuation in galaxies separately and to test its effects at different stellar age and mass regimes.
Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15347
Program Title: Rapid observations of the first gravitational wave counterparts

Principal Investigator: Andrew Levan
PI Institution: The University of Warwick

We propose a series of disruptive ToO observations of the first electromagnetic counterparts to gravitational wave sources. These observations will track the likely rapidly fading counterparts to levels a factor 10 fainter than possible from the ground. They will determine the spectral and temporal evolution, evaluate their power sources, ascertain their contribution to the production of heavy elements in the Universe, pinpoint them on their host galaxies, characterise their environments and provide information to hone further searches. These observations will provide a unique and powerful view of a newly discovered, but long awaited class of astronomical object.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: SNAP
Scientific Category: Stellar Physics
ID: 15348
Program Title: The counterparts and environments of magnetars

Principal Investigator: Andrew Levan
PI Institution: The University of Warwick

We request a series of SNAPSHOT observations of the locations of highly magnetic neutron stars -- so called magnetars. Our multicolour observations, in tandem with extant sub-arcsecond localisations from Chandra, will enable the unambiguous identification of a sample of magnetar counterparts for the first time, while also providing an unparalleled view of the magnetar environment. Once found these magnetar counterparts will provide unique insights into magnetar emission mechanisms, pinpoint the stellar clusters of their birth, enable long term proper motions that will allow the dynamics (e.g. kicks) of magnetars to be compared to normal pulsars, and provide targets for JWST spectroscopy, underpinning the next decade of efforts to understand these extreme neutron stars, their origin and their roles as central engines in many of the most powerful explosions in the Universe.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15349
Program Title: From the longest GRBs to the brightest supernovae

Principal Investigator: Andrew Levan
PI Institution: The University of Warwick

Observations in the past few years have uncovered new populations of high energy transients with durations 1-3 orders of magnitude longer than classical long-duration gamma-ray bursts (GRBs). Recently, a very luminous supernova has been uncovered in one of these events, and it seems likely that its luminosity is related to the late time activity of the central engine of the GRB. If this is the case then it provides a crucial link between central engine input and the peak luminosity of a supernova, with direct relevance to studies of the superluminous SNe that have been uncovered by wide field surveys in the past decade. Here we propose a series of HST observations of an ultralong event uncovered in Cycle 25 or 26. Our observations will map the lightcurve from peak out to late times, distinguish if it can be powered by radioactive Nickel or requires a central engine contribution, and directly test if central engine models can simultaneously produce both the GRB and SNe light. This may provide evidence of a link between two of the most powerful types of explosions known, in which the timescale over which the energy is emitted from a compact object created during core collapse is a governing factor that determines the type of explosion we observe.
Proposal Category: AR
Scientific Category: Galaxies and the IGM
ID: 15037
Program Title: Unifying the Interstellar Extinction and Elemental Abundances: A Comprehensive Study of the Dust Properties in Individual Interstellar Sight Lines
Principal Investigator: Aigen Li
Pl Institution: University of Missouri - Columbia

While it is well recognized that both the Galactic interstellar extinction curves and the gas-phase abundances of C, O and other metal elements exhibit considerable variations from one sightline to another, as yet most of the dust extinction modeling efforts have been directed to the Galactic average extinction curve which is obtained by averaging over many clouds of different gas and dust properties. Therefore, any details concerning the relationship between the dust properties and the interstellar environments are lost. By utilizing the wealth of extinction and abundance data obtained by IUE, HST, and FUSE, we propose to explore the dust properties of over 100 individual sight lines by simultaneously both fitting the observed extinction curve from the near-infrared to the far-ultraviolet and conforming to the observed abundance constraints. This will allow us to gain insight into the physical nature of interstellar grains and how they are related to the physical and chemical conditions of their environments. The results of this research will greatly benefit the analysis and understanding of previously acquired data from GHRS and STIS and future data obtained with STIS.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15282
Program Title: Transport of magnetic fields into the circumgalactic medium

Principal Investigator: Simon Lilly
PI Institution: Eidgenossiche Technische Hochschule (ETH)

Supernova-driven winds are known to play a major role in galaxy evolution, and to drive metal-enriched material far out into the circum-galactic medium. We have demonstrated that magnetic fields in these winds are detectably modifying the polarization properties of background radio quasars with intervening MgII 2799 absorption in their spectra, through Faraday Rotation. We have obtained estimates of the disordered fields within these Faraday screens and wish to map how these vary around galaxies, e.g. whether they are maximal above the poles of the galaxies as we would expect for biconical outflows. We also want to compare our estimates quantitatively with magnetohydrodynamical models that we have been developing. For both investigations, we need to know where the lines of sight pass, relative to the galaxies. For this we need HST resolution images of the host galaxies to establish the orientation and inclination of the disks, and the general morphologies of the galaxies. We have in hand images for 17/30 quasars, and request here images for the remaining 13 sources.
Proposal Category: AR
Scientific Category: Stellar Physics
ID: 15038

Program Title: Model Atmospheres and Spectral Irradiance Library of the Exoplanet Host Stars Observed in the MUSCLES Survey

Principal Investigator: Jeffrey Linsky

PI Institution: University of Colorado at Boulder

We propose to compute state-of-the-art model atmospheres (photospheres, chromospheres, transition regions and coronae) of the 4 K and 7 M exoplanet host stars observed by HST in the MUSCLES Treasury Survey, the nearest host star Proxima Centauri, and TRAPPIST-1. Our semi-empirical models will fit the unique high-resolution panchromatic (X-ray to infrared) spectra of these stars in the MAST High-Level Science Products archive consisting of COS and STIS UV spectra and near-simultaneous Chandra, XMM-Newton, and ground-based observations. We will compute models with the fully tested SSRPM computer software incorporating 52 atoms and ions in full non-LTE (435,986 spectral lines) and the 20 most-abundant diatomic molecules (about 2 million lines). This code has successfully fit the panchromatic spectrum of the M1.5--V exoplanet host star GJ--832 (Fontenla et al. 2016), the first M star with such a detailed model, and solar spectra. Our models will (1) predict the unobservable extreme-UV spectra, (2) determine radiative energy losses and balancing heating rates throughout these atmospheres, (3) compute a stellar irradiance library needed to describe the radiation environment of potentially habitable exoplanets to be studied by TESS and JWST, and (4) in the long post-HST era when UV observations will not be possible, the stellar irradiance library will be a powerful tool for predicting the panchromatic spectra of host stars that have only limited spectral coverage, in particular no UV spectra. The stellar models and spectral irradiance library will be placed quickly in MAST.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Stellar Physics  
ID: 15314  
Program Title: High Fidelity Imaging of a Red Supergiant's Circumstellar Material

Principal Investigator: Jamie Lomax  
PI Institution: University of Washington

In young and low mass environments, where ABG stars have yet to form and WC stars are intrinsically rare, red supergiants (RSGs) are thought to be the main source of circumstellar dust due to their dusty winds. A recent discovery of large grains around VY CMa that will escape from the system before its central star becomes a SN has further strengthened this idea. At the same time, it is unclear what physical scenario is responsible for the large mass-loss rates of RSGs. Characterizing the morphologies of circumstellar material close to RSGs is likely the only way to distinguish between these scenarios. We have recently obtained high-contrast coronagraphic imagery of material around a RSG that appears to be viewed at a low inclination angle. Because of the observing techniques used by ground-based extreme adaptive optics systems to remove PSF residuals, much of the dust signal has likely been self-subtracted from our dataset. The only way to fully characterize the morphology of this material is to use the coronagraphic capabilities HST/STIS. Therefore, we ask for 8 orbits to obtain new imagery of this system using a previously proven high-fidelity coronagraphic imaging technique.
Closely-orbiting, massive planets can measurably affect the activity of their host star through tides, magnetic disturbances, or even mass transfer. Observations of these star-planet interactions (SPIs) provide a window into stellar and planetary physics that may eventually lead to constraints on planetary magnetic fields. Recently, the MUSCLES Treasury Survey of 11 exoplanet host stars revealed correlations providing the first-ever evidence of SPIs in M dwarf systems. This evidence additionally suggests that N V 1238,1242 Angstrom emission best traces SPIs, a feature that merits further investigation. To this end, we propose an experiment using the M dwarf + hot Neptune system GJ 436 that will also benefit upcoming transit observations. GJ 436 is ideal for an SPI experiment because (1) escaped gas from its known rapidly evaporating hot Neptune could be funneled onto the star and (2) it displays a tentative SPI signal in existing, incomplete N V observations. The proposed experiment will complete these N V observations to constrain a model of modulation in N V flux resulting from a stellar hot spot induced by the planet. The results will provide evidence for or against hot spot SPIs producing the correlations observed in the MUSCLES Survey. Furthermore, the acquired data will establish a broader FUV baseline to constrain day-timescale variability and facular emission in FUV lines, needed for the interpretation of upcoming transit observations of GJ 436b. For this reason, we waive our proprietary rights to the data. Establishing GJ 436’s baseline FUV variability and testing the hot spot hypothesis are only possible through the FUV capabilities of HST.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15140
Program Title: Resolving the Connection Between Superluminous Supernovae and Star Formation in Dwarf Galaxies

Principal Investigator: Raghnild Lunnan
PI Institution: California Institute of Technology

Hydrogen-poor superluminous supernovae (SLSN-I) are a rare class of transients with peak luminosities 10-100x those of ordinary SNe and unique spectra. Now a decade after their first discoveries (and even with >50 objects found), fundamental questions like their energy sources and progenitors are still unknown. A strong clue comes from their host galaxy environments: SLSN-I show an overwhelming preference for low-mass, low-metallicity dwarf galaxies, many of which are also undergoing a starburst. Whether this is purely a metallicity effect or also require extreme star formation conditions is debated, but the latter scenario predicts a correlation between the local SN environments and the host galaxy star formation as traced by UV light. This prediction is testable with resolved HST imaging and precise astrometry, though initial studies have been inconclusive due to small number statistics. Here we propose to remedy this by obtaining resolved rest-frame UV imaging of 22 SLSN-I host galaxies from the Palomar Transient Factory SLSN sample, which will nearly triple the sample with HST imaging compared to previous studies and allow this question to be settled with robust statistics. At the current discovery rate of SLSNe, a similar improvement will not be possible until the LSST era.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Galaxies and the IGM  
ID: 15283  
Program Title: Witnessing the assembly of galaxies in an extended gas-rich structure at $z \sim 3.25$

Principal Investigator: Ruari Mackenzie  
Institution: Durham Univ.

The direct study of star formation in Damped Lyman Alpha systems (DLAs), the reservoirs of the majority of neutral gas at high redshift, has previously been hampered by the lack of deep integral field spectroscopy for sensitive searches of faint host galaxies. Building on our successful HST "shot-in-the-dark" survey that has probed the in-situ star formation rate of $z \sim 2-3$ DLAs, we have initiated a MUSE follow-up of 6 DLA signlines to overcome this bottleneck. In the first sightline we have studied, we have uncovered a $\sim 40$ kpc Lyman alpha emitting nebula, composed of two clumps within $\sim 50$ kpc of the DLA, suggestive of a merger or an extended protodisk. Within this structure, which is the largest nebula known to be associated with a $z \sim 3$ DLA, we also found a compact continuum source with spectrophotometry consistent with a Lyman Break Galaxy at the same redshift. Aside from the LBG, the rest of the Lyman alpha structure has no continuum counterpart in deep UV and visible imaging. The LBG alone seems unable to power the Lyman alpha nebula and the morphology supports our conclusion that, most likely, this structure is powered by in-situ star formation below detection limit. However, from the Lyman alpha alone the origin of this incredible structure remains ambiguous. With this proposal, we aim to acquire high resolution, deep infrared imaging with HST to probe the rest-frame optical emission to search for the underlying stellar emission of this object and to infer the stellar mass of the LBG. With the powerful combination of HST and MUSE data, we will unravel the nature of this unique system.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Massive Black Holes And Their Host Galaxies  
ID: 15350  
Program Title: Resolved BPT Mapping of Nearby AGN

Principal Investigator: Walter Maksym  
PI Institution: Smithsonian Institution Astrophysical Observatory

Via BPT mapping using Hubble narrow filters, we have identified a "LINER cocoon" surrounding the ionization cone of the Seyfert 2 Galaxy NGC 3393. We propose to test the generality of "LINER cocoons" by observing 19 nearby AGN in the BPT definitional emission lines. We will use narrow filter observations of [S II] 6717,6731 AA and H-beta to survey a diverse sample of nearby Seyfert galaxies which already have [O III] 5007 AA and H-alpha. By mapping [O III]/H-beta and [S II]/H-alpha, we will create Baldwin-Phillip-Terlevich (BPT) maps of the ionization bicones and surrounding areas, resolved on scales of only ~10 pc. We will use these maps to investigate effects of morphology, bicone orientation, and AGN luminosity on LINER production, which will provide important insights to LINERS produced by unresolved AGN at larger redshifts.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Massive Black Holes And Their Host Galaxies
ID: 15351
Program Title: Continued Long-Term Ultraviolet Spectroscopy of a Tidal Disruption Event at only 90 Mpc

Principal Investigator: Walter Maksym
PI Institution: Smithsonian Institution Astrophysical Observatory

We propose continued long-term multi-epoch ultraviolet spectroscopy of ASASSN-14li, a stellar tidal disruption event (TDE) at ~90 Mpc. Such a bright, nearby stellar TDEs provides an exceptional opportunity to study broad emission lines which describe the abundances and accretion flow of the stellar debris in one of the most important physical regimes for understanding basic TDE behavior. We also request brief XMM observations to constrain the high-energy spectral evolution on similar timescales. These observations will build upon surprising new results, and will provide an important foundation for follow-up of more ambiguous TDE candidates subsequently identified by LSST and WFIRST at higher redshifts.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Planets and Planet Formation
ID: 15079
Program Title: Spectroscopic characterization of a newly detected young planet right outside a circumbinary transition disk

Principal Investigator: Carlo Manara

PI Institution: European Space Agency - ESTEC

Direct high-contrast imaging has discovered a number of substellar companions to date. Most of them are located at large separations of 10s or 100s of au. The formation of such massive objects with several Jupiter masses at the large distances at which they reside is not well understood by planet formation models. The formation timescales of such planets is much larger than the typical disk dissipation time. Most of the detected substellar companions are located in old, typically >10Myr, systems where we can only study the remnants of the circumstellar disks in the form of debris belts. We detected for the first time a planet in a young (2 Myr) system right outside of a dust and gas rich circumbinary disk, which we also resolve in (polarized) scattered light using the extreme adaptive optics Imager SPHERE at the ESO Very Large Telescope. We already confirmed that the object is co-moving with the primary star and now ask for follow up spectroscopy with the sole instrument capable of it, HST/WFC3, to firmly derive its mass.
Proposal Category: SNAP
Scientific Category: Cosmology
ID: 15242
Program Title: SNAPshot observations of the largest sample of lensed candidates in the Equatorial and Southern Sky identified with Herschel

Principal Investigator: Lucia Marchetti

PI Institution: Open University

We propose WFC3/IR F110W Snapshot observations of 200 gravitational lensing systems selected using Herschel submm data taken in all the major Herschel extragalactic surveys (over ~850 square degrees). This proposal aims to build upon the successful results of our cycle-19 snapshot (ID:12488) to complete the study of the brightest lensed galaxies ever discovered by Herschel in the Equatorial and Southern Sky. Our successful submm-based selection method identifies lensing events at much higher redshift than any other optical-based selection and is independent of the nature of the magnifier. With these data we will (1) characterize the morphology of the lenses and thus statistically determine what populations are responsible for the gravitational optical depth of the Universe, (2) make accurate fits to the lens light profiles disentangling the foreground lenses from the background sources (3) constrain (and in some cases directly detect) the rest-frame optical emission from the background sources providing estimates of the background source extinction, (4) identify the most extreme star-forming galaxies and rare lensing configurations in the Universe providing the best candidates for future ALMA follow-up, (5) measure the evolution of both the lens mass-density profile, constraining their assembly history, and the lens IMF. This HST program is well-timed with our on-going large spectroscopic program with SALT (3-year program, started in late 2015). This synergy guarantees the timely spectroscopic characterization of our targets securing a long-lasting legacy for this program.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

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<td>Program Title:</td>
<td>Origin of the high velocity gas in NGC 6231</td>
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**Principal Investigator:** Derck Massa  
**PI Institution:** Space Science Institute

It is well known that clusters of massive stars are influenced by the presence of strong winds, that they are sources of diffuse X-rays from shocked gas, and that this gas can be vented into the surrounding region or the halo, forming a critical element in the process of galactic feedback. However, the details of how these different environments interact and evolve are far from complete. Recently, Massa (2017) showed that the peculiar C IV 1550 Ang absorption seen in several otherwise normal main sequence B stars in NGC 6231 is not intrinsic to the stars. Instead, this absorption, which extends to more than -2000 km/s, is due to intervening carbon rich, high speed gas in the cluster environment. In this proposal, we seek to identify the origin of the high speed gas. The proposed observations will enable us to determine whether it is due to the outer wind of the WC star WR79, or to a collective cluster wind, enriched by carbon from the wind of WR79. If it is due to the wind of WR79, then the new data will furnish a novel, less model dependent estimate of the mass loss rate of a WC star. If it is due to a collective wind from the cluster, then we could be witnessing an important stage of galactic feedback. In either case, the proposed observations will provide a unique and significant insight on how massive, open clusters evolve — insight that can only be obtained through UV spectroscopy.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: AR  
Scientific Category: Galaxies and the IGM  
ID: 15039  
Program Title: Towards an Understanding of the Origin of OVI in the Circumgalactic Medium

Principal Investigator: Michael McCourt  
PI Institution: University of California - Santa Barbara

HST COS observations have unexpectedly discovered ubiquitous OVI-absorbing gas around star forming galaxies, constituting a substantial fraction (10% or more) of the galaxy's baryonic mass. This is extremely surprising: in collisional ionization equilibrium, OVI peaks only in narrow temperature range around \( \sim 2e5 \) K, below the virial temperature. In steady-state, such a large mass of gas at this temperature implies a cooling flow of 30 Msun/year or more! Other unexplained properties include kinematic similarities with low ionization lines and a relative dearth of OVI in quiescent galaxies.

We will study the origin of OVI gas using semi-cosmological simulations which 'grow' a galaxy halo with a specified accretion history, including star formation and feedback physics. Unlike cosmological zoom-in simulations, which focus on resolving the disks of galaxies, our simulations are specifically designed to study the CGM and enable us to cover a wide range of parameter space at high resolution. We show a simulation which produces OVI profiles in excellent agreement with observations, with no fine-tuning. Here, OVI arises from a thick, partially-photoionized shell outside the virial radius; this critically requires that gas in galaxy outskirts be metal enriched and low pressure. We will study the physical origin of this result, and how OVI observations probe galaxy formation and CGM physics. We will generate OVI and other metal line profiles which can be directly compared against HST observations. Key predictions to explore are the disappearance of OVI gas in higher mass or redshift halos (where higher pressures prevail), and OVI in emission or resonant scattering.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Cosmology
ID: 15315
Program Title: Revealing Thermal Instabilities in the Core of the Phoenix Cluster

Principal Investigator: Michael McDonald
PI Institution: Massachusetts Institute of Technology

The Phoenix cluster is the most relaxed cluster known, and hosts the strongest cool core of any cluster yet discovered. At the center of this cluster is a massive starburst galaxy, with a SFR of 500-1000 Msun/yr, seemingly satisfying the early cooling flow predictions, despite the presence of strong AGN feedback from the central supermassive black hole. Here we propose deep narrow-band imaging of the central ~120 kpc of the cluster, to map the warm (10^4K) ionized gas via the [O II] emission line. In low-z clusters, such as Perseus and Abell 1795, the warm, ionized phase is of critical importance to map out thermal instabilities in the hot gas, and maps of Halpha and [O II] have been used for decades to understand how (and how not) cooling proceeds in the intracluster medium. The data proposed for here, combined with deep ALMA data, a recently-approved Large Chandra Program, and recently-approved multi-frequency JVLA data, will allow us to probe the cooling ICM, the cool, filamentary gas, the cold molecular gas, the star-forming population, and the AGN jets all on scales of <10 kpc. This multi-observatory campaign, focusing on the most extreme cooling cluster, will lead to a more complete understanding of how and why thermal instabilities develop in the hot ICM of cool core clusters.
The importance of major merging at z>1 remains in question despite the rapid buildup and development of massive galaxies at these epochs. New theories and observations suggest that non-merging processes like disk instabilities may be even more important than previously thought at assembling bulges, producing clumps, and inducing morphological disturbances that may be misinterpreted as the product of major merging. We propose a novel search for tidal features on a complete sample of nearly 6000 massive z>1 galaxies from CANDELS. Our novel approach will use improved residual maps from multi-component fits to archival WFC3 images, and a new machine learning classification pipeline to robustly identify transient and faint tidal signatures: the hallmark sign of major merging. We will repeat this analysis on synthetic mock images to thoroughly quantify the impacts of cosmological dimming, and calibrate the observability timescale of tidal feature detections. Our study will yield (1) definitive census of massive z>1 galaxies with merger tidal signatures from CANDELS, (2) critically important calibrations for converting tidal detections into merger rates, (3) two novel software pipelines, (4) new stringent tidal-based merger rates that will provide critical tests of theoretical predictions on the relative importance of ex-situ (hierarchical merging) vs. in-situ (gas accretion, cooling, and star formation) assembly of massive galaxies.
Proposal Category: GO
Scientific Category: Stellar Populations
ID: 15243
Program Title: The Leoncino Dwarf: The Lowest Metallicity Star-Forming Galaxy in the Nearby Universe

Principal Investigator: Kristen McQuinn
PI Institution: University of Texas at Austin

Extremely metal-poor (XMP) galaxies are dwarf irregular galaxies with very low metallicities, traced by their gas-phase oxygen abundance. Galaxy evolution scenarios suggest three pathways to form an XMP: (1) secular evolution at low galaxy masses, (2) slow evolution in voids, or (3) dilution of measured abundances from infall of pristine gas. These scenarios have proven challenging to test because, despite concerted efforts, XMP galaxies in the nearby universe have proven hard to find.

A notable exception is the recently discovered dwarf galaxy Leoncino. Leoncino has the lowest gas-phase oxygen abundance ever measured in a galaxy in the local Universe. From optical spectroscopy, the oxygen abundance is $12 + \log(O/H) = 7.02 \pm 0.03$, more than 40% lower than the iconic low-metallicity galaxy I Zw 18 and less than 2% $Z_{\odot}$.

Despite a precision oxygen abundance measurement, the evolutionary context of Leoncino remains uncertain without a secure distance. We propose HST WFC3 high-resolution optical imaging of Leoncino to accurately measure the distance to the galaxy using the tip of the red giant branch (TRGB) method. The distance will determine whether Leoncino is located in a typical field environment or in a void, and whether the galaxy is consistent with the luminosity-metallicity relation at low galaxy masses. The detailed study of Leoncino will provide benchmark results for future XMP discoveries in the nearby Universe, and an exceptionally timely comparison for studies of chemically primitive, high-redshift galaxies that will be observable in the JWST era.
Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15141
Program Title: The 6 pc DASH: A WFC3 1.6 micron Survey of the Orion Integral Shaped Filament

Principal Investigator: Tom Megeath

PI Institution: University of Toledo

We propose a 1.6 micron WFC3 survey of the 6 pc long integral shaped filament (ISF) in the Orion A cloud using the DASH (drift and shift) method. At a distance of 388 pc, the 6000 solar mass ISF is the nearest region of massive star formation, sits directly behind the Orion Nebula, and hosts the Orion Nebula Cluster with over 2000 low mass stars. It is the best laboratory for understanding the network of processes, such as gas fragmentation and collapse, feedback from outflows and radiation, and dynamical interations, found in massive filamentary clouds. Using the DASH method, we will efficiently map a 6 x 0.9 pc strip along the length the ISF with 80 AU resolution in the F160W band. With these data we will search for multiple systems, obtaining excellent statistics on multiplicity as a function of environment, resolve protostellar envelopes and edge-on disks, and comparing to previous HST data, measure proper motions of stars and search for time variable scattered light nebulae. These observations will build on a long legacy of ISF observations, and they will set the stage for observations with JWST and WFIRST.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Planets and Planet Formation  
ID: 15080  
Program Title: Is SDSSJ195750.83+340404.4 accreting a planetary core?

Principal Investigator: Carl Melis  
PI Institution: University of California - San Diego

White dwarf stars are now known to regularly accrete material from their extant planetary systems. We have identified a new polluted white dwarf star that is accreting extremely iron-rich material, suggesting that it is being polluted by the core of a massive, differentiated rocky body. We propose COS FUV spectroscopic observations of SDSSJ1957+3404 that will allow us to peer into the heart of Earth-like rocky exoplanets. These observations will address questions pertaining to terrestrial planet structure and formation processes and the question of what mixture of elements is responsible for Earth's under-dense outer core.
Proposal Category: AR
Scientific Category: Stellar Physics
ID: 15041
Program Title: The Role of Shocks in the Appearance and Aftermath of Stellar Mergers and Type IIn Supernovae

Principal Investigator: Brian Metzger
PI Institution: Columbia University in the City of New York

HST has played a crucial role in elucidating the environments, progenitors, explosions, and late-time behavior of Type IIn supernovae (SNe) and binary star mergers (also known as common envelope events). Although shock interaction plays a dominant role in the dynamics and appearance of these events, the details of this process and the nature of the mass loss leading up to the core collapse or dynamical stage of the merger, remain poorly understood. Mounting evidence suggests that the pre-explosion mass loss geometry is a disk or equatorially-concentrated outflow. We will perform the first multi-dimensional radiation hydrodynamical simulations of the shock interaction between the fast ejecta from the SN explosion/dynamical merger and a slower equatorially-focused outflow representing the earlier phase of mass loss. Our calculations will quantify the geometry of the ejecta and make detailed predictions for the shock-powered emission. In combination with an analytic model to be developed in parallel, we will translate the light curves and spectral information on a large sample of IIn SNe and stellar mergers into probes of their mass loss history. We will address whether the combination of hydrogen recombination and shock-powered emission can explain the common double-peaked nature of the light curves of stellar mergers. By accounting self-consistently for the role of radiative shock compression on the ejecta density structure, and thus on the global geometry and microphysical properties of dust grains formed, we will also address the late-time appearance of IIn SNe and stellar mergers observed by HST and JWST.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Massive Black Holes And Their Host Galaxies  
ID: 15175  
Program Title: An Infrared Imaging Test of the IC/CMB Model for the Unusual Spectrum of AP Librae  

Principal Investigator: Eileen Meyer  
PI Institution: University of Maryland Baltimore County

We propose infrared imaging of a recently-discovered anomalous X-ray emitting jet in the nearby source AP Librae, which underwent a flare observed by the Fermi gamma-ray space telescope in August 2016. The H.E.S.S. observatory also unexpectedly detected this source at TeV energies in 2015. Multiple papers have been written since the H.E.S.S. discovery speculating on the emission process due to the extremely broad and unusually shaped spectrum from X-rays to very high energy, and it has been claimed that the $\nu>10$ GeV through TeV emission is not from the unresolved blazar core, but rather inverse-Compton upscattering of CMB photons by a still highly-relativistic kpc-scale jet. However, this model is called into question by the recent flaring activity. A clear test of the IC/CMB model can be made through a short WFC3/IR observation due to the fact that the model makes a fixed prediction for the precise level of infrared emission from the jet. Further, if the infrared emission is confirmed, the IC/CMB model implies fast proper motions on the kpc scale, on the order of 10$c$, which can be easily detected via a follow-up HST observation in ~3-4 years, which is just possible within the operating lifetime of Hubble, with the currently proposed observations serving as the first epoch. A non-detection would clearly rule out the IC/CMB model, and either result would inform the approach for appropriate follow-up observations with HST, ALMA, and Chandra.
The CIII\textsuperscript{1}909 line is strongly detected in high redshift star-forming (SF) galaxies of low mass and metallicity, and has therefore been proposed as a new probe of galaxies close to the epoch of reionization. However, spectroscopic results at lower redshifts indicate that strong CIII\textsuperscript{1} emission is not ubiquitous among distant SF galaxies. Observations show that galaxies of similarly modest stellar masses, low metallicities, and high ionization parameters can either be strong or weak CIII\textsuperscript{1} emitters. This is contrary to expectations from photoionization models, which predict strong CIII\textsuperscript{1} emission from such sources. Clearly, the dependence of the total integrated CIII\textsuperscript{1} emission on such properties is not yet fully understood.

We propose to obtain CIII\textsuperscript{1} imaging in two local SF galaxies (Haro 11 and Eso338-04) and one giant H II region (Mrk 71) in order to map the surface brightness of this emission with co-spatially inferred properties of individual SF regions. Our targets have a wealth of complementary HST imaging, and IFU data, allowing us to characterize each CIII\textsuperscript{1} emitting region with properties like electron temperature and density, UV slope beta, and ionization parameter. We will quantify the interplay between integrated CIII\textsuperscript{1} flux and flux inferred from individual regions, and compare to predictions from photoionization models. This will help disentangle the currently inconsistent observational results of CIII\textsuperscript{1}, and could potentially reconcile curiously weak CIII\textsuperscript{1} emitters with their otherwise CIII\textsuperscript{1}-boosting properties.

CIII\textsuperscript{1} has recently been suggested as a diagnostic of possible Lyman Continuum (LyC) escape. We will test this on Haro 11, a confirmed LyC emitter.
Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15258
Program Title: Galaxies at the Extremes: Ultradiffuse Galaxies in the Virgo Cluster

Principal Investigator: Chris Mihos
PI Institution: Case Western Reserve University

The "ultradiffuse galaxies" (UDGs) recently discovered in massive galaxy clusters presents both challenges and opportunities for our understanding of galaxy evolution in dense clusters. Such large, low density galaxies should be most vulnerable to gravitational destruction within the cluster environment. Thus their presence in cluster cores argues either that they must be stabilized by massive dark halos or else be short-lived objects undergoing rapid transformation, perhaps leading to the formation of ultracompact dwarf galaxies (UCDs) if their destruction leaves only a compact nucleus behind.

We propose deep imaging of four Virgo Cluster UDGs to probe their local environment within Virgo via accurate tip of the red giant branch (TRGB) distances. With a distance precision of 1 Mpc, we will accurately place the objects in the Virgo core, cluster outskirts, or intervening field. When coupled with our extant kinematic data, we can determine whether they are infalling objects or instead have already passed through the cluster core. We will also compare their compact nuclei to Virgo UCDs, and study their globular cluster (GC) populations in detail. Probing three magnitudes beyond the turnover in the GC luminosity function, we will construct larger and cleaner GC samples than possible with ground-based imaging, using the total mass and radial extent of the globular cluster systems to estimate the dark halo mass and tidal radius for each UDG. The new information provided by HST about the local environment and intrinsic properties of these Virgo UDGs will be used in conjunction with simulation data to study cluster-driven evolution and transformation of low density galaxies.
Proposal Category: GO
Scientific Category: Planets and Planet Formation
ID: 15176
Program Title: Resolving the late planet formation stages around young M-stars

Principal Investigator: Maxwell Millar-Blanchaer
PL Institution: Jet Propulsion Laboratory

Recent discoveries of earth-like planets around M-stars have highlighted the importance of understanding planet formation around late-type stars. However, this effort has been hampered by the lack of resolved observations of protoplanetary disks. In particular, scattered light images of M-star disks near the age of dispersal are critical to making further progress. The Upper Sco region provides a promising venue to remedy this situation, as it is the closest region with an age of 5-11 Myrs, commensurate with dispersal timescales. We propose to observe three M-star protoplanetary disks in the Upper Sco association using HST/STIS coronography to resolve the disks in scattered-light for the first time and to search for morphological signatures of forming planets. These three disks have been selected based on ALMA mm-dust and CO measurements that display radii within the STIS field of view and outside its inner working angle (IWA). We will use these observations to carry out a comparative study of the evolutionary state between M-star disks in Upper Sco and the younger 1-2 Myr Taurus region, leveraging both previous scattered-light images of disks in Taurus, as well as previous observations of the mm-dust and CO in both regions. All three targets are too faint to be observed using ground-based AO. Therefore, HST/STIS is the only instrument able to make these important measurements. These observations will act as critical diagnostics of the evolutionary state of nearby M-star protoplanetary disks, that will inform theories of planet formation and will further our understanding of the evolution of the planets around M-stars, such as our nearest neighbor Proxima Centauri b.
Proposed Category: GO
Scientific Category: Solar System
ID: 15111
Program Title: The UV reflectance of Patroclus: Exploring the surface composition and origins of Jupiter Trojans

Principal Investigator: Pippa Molyneux

PI Institution: Southwest Research Institute

(617) Patroclus is a binary system comprising two almost equally sized Trojan asteroids, Patroclus and Menoetius. (617) Patroclus has never been observed in the UV spectral region, which contains important diagnostic features of major Trojan surface constituents inferred from fits to visible-near IR spectra. Previous spectral observations have not been spatially resolved, precluding a direct spectral comparison of the two bodies. We propose to obtain full surface UV reflectance maps of both Patroclus and Menoetius using the STIS G230L mode, to search for characteristic absorption features of silicates, carbons/graphites and NH3, which together make up the major inferred Jupiter Trojan surface constituents, and for signs of "spectral bluing" that occurs for space-weathered objects. The Jupiter Trojans are believed to represent the most readily accessible Kuiper Belt material in the solar system, having been scattered from that region to their current orbits following a dynamical instability. A direct spectral comparison of Patroclus and Menoetius, indicating whether the objects share a common origin and evolution, will explore the hypothesis that the system is a rare binary survivor of this scattering. (617) Patroclus is also a target of the upcoming Lucy mission, and constraints on surface composition would represent a valuable input to instrument configuration and observation planning work for the mission. As Lucy will not carry a UV instrument, the proposed observations would remain unique and complementary to the results of the mission.
Proposal Category: GO
Scientific Category: Stellar Populations
ID: 15244
Program Title: A challenge to dSph formation models: are the most isolated Local Group dSph galaxies truly old?

Principal Investigator: Matteo Monelli

PI Institution: Instituto de Astrofisica de Canarias

What is the origin of the different dwarf galaxy types? The classification into dwarf irregular (dIrr), spheroidal (dSph), and transition (dT) types is based on their present-day properties. However, star formation histories (SFHs) reconstructed from deep color-magnitude diagrams (CMDs) provide details on the early evolution of galaxies of all these types, and indicate only two basic evolutionary paths. One is characterized by a vigorous but brief initial star-forming event, and little or no star formation thereafter (fast evolution), and the other one by roughly continuous star formation until (nearly) the present time (slow evolution). These two paths do not map directly onto the dIrr, dT and dSph types. Thus, the present galaxy properties do not reflect their lifetime evolution. Since there are some indications that slow dwarfs were assembled in lower-density environments than fast dwarfs, Gallart et al (2015) proposed that the distinction between fast and slow dwarfs reflects the characteristic density of the environment where they formed. This scenario, and more generally scenarios where dSph galaxies formed through the interaction with a massive galaxy, are challenged by a small sample of extremely isolated dSph/dT in the outer fringes of the Local Group. This proposal targets two of these objects (VV124, KKR25) for which we will infer their SFH -- through a novel technique that combines the information from their RR Lyrae stars and deep CMDs sampling the intermediate-age population -- in order to test these scenarios. This is much less demanding on observing time than classical SFH derivation using full depth CMDs.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: AR
Scientific Category: Stellar Physics
ID: 15042
Program Title: Constraining Core-collapse Supernova Theory Predictions with 400 Progenitor Masses

Principal Investigator: Jeremiah Murphy
PI Institution: Florida State University

A new era is emerging in which we will have hundreds of progenitor masses for supernovae (SNe) and supernova remnants (SNRs); we propose to develop the statistical and theoretical tools needed to interpret this data. Two of the fundamental predictions of stellar evolution theory are that stars more massive than about 8 solar masses will explode and that some of these stars will not explode and form black holes. These statements are clear and simple, yet constraining them with observations has remained elusive until recently. For many years, the rate of progenitor discovery was steady but slow; each progenitor discovery required rare serendipitous pre-cursor imaging. With this steady drip of direct imaging, the number of progenitor masses numbered no more than 20. Recently, we developed a technique that increased the number of progenitor masses by a factor of 10 or more. In this new technique, we use HST photometry to age-date the stellar populations surrounding SNRs. From this age, we derive a progenitor mass for each SNR. We currently have progenitor masses for 115 SNRs in M31 and M33, soon we will have 300 more from M83, and there are hundreds more SNRs that could be analyzed in other nearby galaxies. To prepare for this watershed, we propose to develop the Bayesian framework needed to properly infer the progenitor mass distribution. This work will culminate in a direct constraint on the predictions of core-collapse supernova theory.
The attenuation of star light in galaxies by dust imposes a major uncertainty in the derivation of galaxy physical properties. As we show in this proposal, for example, incorrect assumptions about attenuation laws in SED fitting can result in errors of ~0.3 dex in the derived M* and SFR from galaxies. While HST observations have revealed variations in inferred dust attenuation laws, we currently lack a comprehensive theory for how and why attenuation curves vary within and between galaxies. Complicating the issue are both the necessity for 3D radiative transfer modeling (to capture absorption and scattering), as well as a model for the geometry of luminous sources and dust in galaxies. To address this, we propose to conduct a large series of high-resolution cosmological zoom galaxy formation simulations in which we super-resolve giant clouds in the interstellar medium. These simulations will be coupled with a novel 3D dust radiative transfer package in order to derive theoretical dust attenuation curves. Our main scientific goals are twofold: (1) to derive the first ever connection between global properties of galaxies and their dust attenuation laws; and (2) to build better SED fitting techniques in order to improve the accuracy of physical properties inferred from galaxy SED fitting. All of our simulation results, population synthesis codes, and SED fitting codes will be made publicly available.
Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15284
Program Title: Constraining the binary properties of 2M1938+4603 with irradiated stellar atmospheres

Principal Investigator: Peter Nemeth
PI Institution: Astroserver.org

Hot subdwarf stars are the stripped cores of evolved 0.8–2 Msun stars with a mass of 0.5 Msun, likely formed in common-envelope evolution. About a dozen such stars are known to be orbited by faint low mass stars or brown dwarfs on periods of few hours. Their light curves are characterized by eclipses and strong reflection effects due to the heated hemisphere of the cool companion. Hot subdwarfs are promising targets for asteroseismology, because some show multi-periodic oscillations, allowing to determine the stellar mass and internal structure. An ideal laboratory to determine the fundamental parameters would be a pulsating subdwarf in an eclipsing binary as it allows to combine the tools of binary and seismic analyses and provide a benchmark for both fields. Such a system has recently been found by the Kepler space mission: 2M1938+4603 hosts a pulsating hot subdwarf primary and a dM companion in a 181 min. orbit. The radial velocity curve of the primary has been measured, but no spectral features of the companion are accessible in the optical. By modelling the irradiated atmosphere we show that plenty of emission lines from the companion are detectable in the FUV. We expect this spectrum to be superimposed on the absorption line spectrum of the hot subdwarf. With phase resolved spectroscopy we shall identify FUV emission lines and measure the RV amplitude of the companion (~240km/s), the last piece missing in the puzzle. Our models of the companion's irradiated atmosphere will greatly improve the analysis of the accurate Kepler light curve. Our investigations have a high potential as 2M1938 is a benchmark object in the validation of binary evolution and seismic models.
The abundance of dark matter subhalos is a fundamental prediction of LCDM. Testing this prediction is difficult as low mass subhalos contain few or no stars, and these stars trace only the innermost portion of the halo potential. Gravitational lensing of background quasars is a powerful tool which enables the detection and mass measurement of low mass dark matter subhalos via perturbations to lensed image magnifications. While this method was demonstrated in 2002 on a sample of 7 systems, the field has been limited by the lack of additional lens discoveries. We propose to apply our proven method of using the HST grism to measure microlensing-free narrow-line flux ratios in a set of 9 recently discovered quasar lenses. When combined with the systems from our previous sample, (GO-13732), and ground based study, this unprecedented sample of 18 lenses will enable a robust detection of tens of low mass $M(< 600) \sim 10^7$ Msun subhalos, which exist well within the regime in which the majority of halos are expected to be dark. After accounting for uncertainties related to baryonic physics, if CDM is correct, we will detect twice as many dark matter subhalos per lens as gravitational imaging studies which are sensitive to subhalos $M(< 600) > 10^8$ Msun. In the case of 3 keV WDM, we expect the same detection rate as gravitational imaging studies given that the majority of subhalos below their sensitivity range will be destroyed. Our measurement will provide a powerful new window into the low mass Universe.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Stellar Physics  
ID: 15178  
Program Title: Probing jets from young embedded sources

Principal Investigator: Brunella Nisini  
PI Institution: INAF, Osservatorio Astronomico di Roma

Jets are intimately related to the process of star formation and disc accretion. Our present knowledge of this key ingredient in protostars mostly relies on observations of optical jets from T Tauri stars, where the original circumstellar envelope has been already cleared out. However, to understand how jets are originally formed and how their properties evolve with time, detailed observations of young accreting protostars, i.e. the class 0/I sources, are mandatory. The study of class0/I jets will be revolutionised by JWST, able to penetrate protostars dusty envelopes with unprecedented sensitivity and resolution. However, complementary information on parameters inferred from lines in different excitation regimes, for at least a representative sample of a few bright sources, is essential for a correct interpretation of the JWST results. Here we propose to observe four prototype bright jets from class0/I sources with the WFC3 in narrow band filters in order to acquire high angular resolution images in the [OI]6300A, [FeII]1.25 and [FeII]1.64um lines. These images will be used to: 1) provide accurate extinction maps of the jets that will be an important archival reference for any future observation on these jets. 2) measure key parameters as the mass flux, the iron abundance and the jet collimation on the hot gas component of the jets. These information will provide an invaluable reference frame for a comparison with similar parameters measured by JWST in a different gas regime. In addition, these observations will allow us to confront the properties of class 0/I jets with those of the more evolved T Tauri stars.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Solar System  
ID: 15142  
Program Title: Orbit of a Resolved Trojan Binary

Principal Investigator: Keith Noll  
PI Institution: NASA Goddard Space Flight Center

We have identified the Jupiter Trojan (16974) 1998 WR21 as a binary, making it only the third known resolvable binary in this population. We will use HST to determine its orbit from which we will determine the system mass. Using the mass and WISE-derived albedo, we will derive the density. Density can be used to constrain planetary migration models; low density is characteristic of bodies found in the Kuiper Belt, a remnant of the solar system's protoplanetary disk. Only one undisputed density has been measured in the Trojans, that of the binary (617) Patroclus, which has a low density of 800 kg/m3. The density of WR21 will test whether Patroclus is an anomaly or whether low densities might be the norm, as they are in the Kuiper Belt.
Proposal Category: GO
Scientific Category: Solar System
ID: 15143
Program Title: Slow Rotating Trojans: Tidally Synchronized Binaries?

Principal Investigator: Keith Noll
PI Institution: NASA Goddard Space Flight Center

We propose HST observations of six slow-rotating Trojans to search for tidally synchronous binaries similar to the Patroclus binary system. A significant excess of slow rotators over Maxwellian suggests that additional binaries may be present. If any of the targets are binary, they can be resolved by HST. This target selection strategy has recently yielded the third known resolved Trojan binary, detected in a sample of seven slow-rotating Trojans. We wish to extend this successful strategy with another similarly selected sample. Even one additional resolved binary in the Trojans, which would become the fourth, would be of extreme interest. The discovery of no binaries among this group of slow rotators would challenge the understanding of the source of the excess slow rotators in the Trojans.
Proposal Category: GO
Scientific Category: Solar System
ID: 15144
Program Title: Deep Search for Satellites Around the Lucy Mission Targets

Principal Investigator: Keith Noll
PI Institution: NASA Goddard Space Flight Center

By performing the first deep search for Trojan satellites with HST we will obtain unique constraints on satellite-forming processes in this population. We have selected the targets from NASA’s Lucy mission because they represent a taxonomically and physically diverse set of targets that allow intercomparisons from a small survey. Also, by searching now to identify any orbiting material around the Lucy targets, it will be possible impact hardware decisions and plan for maximum scientific return from the mission. This search also is a necessary step to assure mission safety as the Lucy spacecraft will fly within 1000 km of the targets, well within the region where stable orbits can exist.
Proposal Category: AR
Scientific Category: Stellar Physics
ID: 15044
Program Title: Unveiling hidden companions in post-AGB stars: 3D simulations of evolved star binaries

Principal Investigator: Jason Nordhaus
PI Institution: Rochester Institute of Technology

The deaths of ordinary stars are marked by extraordinary transitions. For those with initial masses <8 M_sun, the geometry of the outflows rapidly change from the spherical dust-driven winds seen in the giant phases to the iconic HST images of asymmetric post-Asymptotic-Giant-Branch and planetary nebulae (PNe). Measurements of post-AGB/PN nebular kinematics suggest that most (if not all) of these systems likely possess close, hidden companions responsible for the breaking of symmetry and the extreme momenta/energy observed in the outflows. However, it is notoriously difficult to detect such companions as the dusty outflows make direct detection improbable and efficiently mask radial velocity signatures.

To address this issue, we have selected four post-AGB/PN systems that have comprehensive multi-epoch, multi-wavelength archival data obtained over the past 10-15 years. For each system, we will perform fully-dynamical 3D binary simulations using the AMR code AstroBEAR. Our results will be compared to the broadband SED, and multi-epoch proper motion and archival images to constrain properties of the companions responsible for the outflow kinematics. We have successfully demonstrated this technique in L2 Puppis (one of the nearest Mira-like systems), where we were able to fully match the multi-wavelength observational data for the system if an unseen planet were present. Since then, ALMA has tentatively detected such a planet in L2 Puppis.

Lastly, this award will provide partial funding for a deaf graduate student. Professor Nordhaus is fluent in American Sign Language and working to increase opportunities for deaf and hard-of-hearing students in
Proposal Category: GO
Scientific Category: Massive Black Holes And Their Host Galaxies
ID: 15245
Program Title: The Co-Evolution of Star Formation and Powerful Radio Activity in Galaxies During Radio-Mode Feedback

Principal Investigator: Christopher O'Dea
PI Institution: University of Manitoba

Feedback from radio sources is thought to be a key ingredient in determining the shape of the galaxy luminosity function. Compact Steep Spectrum (CSS) radio sources are galactic scale (1-20 kpc) and so probe radio source feedback to the host galaxy. We propose to carry out WFC3 UV imaging of the line-free continuum between [CIII] 1909 and MgII 2798, as well as WFC3 line-free optical continuum imaging, in nine CSS radio sources. Following our pilot study that detected spatially extended UV radiation in 3/3 CSS sources, we propose observations which will increase our total sample size by a factor of 4. Imaging the UV continuum from hot massive stars is the best way to study recently triggered and ongoing star formation. We will map in detail the star formation regions in relation to the radio structures and multiwavelength properties of the sources. The high spatial resolution will allow us to separate morphologically and characterize the generic star formation which is due to gas infall, and that which is due to triggering by the radio source.
Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15352
Program Title: Lyman alpha and ISM Tomography of Haro 11

Principal Investigator: Goeran Oestlin
PI Institution: Stockholm University

The compact starburst Haro11 is one of the nearest Lyman break analogs and the closest galaxy with a confirmed leakage of Lyman continuum photons. It is also one of the nearest Lyman alpha emitting galaxies known. Haro11 has three bright emission knots (A,B and C), Knot C It has previously been observed with COS. We have used absorption lines in these spectra to determine the covering fraction and velocity structure of the neutral and ionized gas along the line of sight, finding a wide range of outflow velocities and covering fractions, indicating the presence of an outflowing clumpy ISM. These are conditions that should be benign for the escape of Lyman continuum emission, but there are other observations suggesting that knot C may not be the cause of the Lyman continuum leakage: its ionization level is low, and there is no Lyman alpha at the systemic velocity which one would predict if Lyman continuum was escaping through a clumpy medium. We propose COS spectroscopy of the other two knots and two positions showing bright diffuse Lyman alpha emission. With multiple sightlines probing the ISM and Lyman alpha emission we can perform a spatially resolved tomographic study of the ISM and Lyman alpha emission in this key galaxy. By adding STIS spectroscopy, we propose to furthermore study these processes at the finest scale offered by HST.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: AR
Scientific Category: Galaxies and the IGM
ID: 15045
Program Title: HI and Low Metal Ions at the Intersection of Galaxies and the CGM

Principal Investigator: Benjamin Oppenheimer
PI Institution: University of Colorado at Boulder

Over 1000 COS orbits have revealed a surprisingly complex picture of circumgalactic gas flows surrounding the diversity of galaxies in the evolved Universe. Cosmological hydrodynamic simulations have only begun to confront the vast amount of galaxy formation physics, chemistry, and dynamics revealed in the multi-ion CGM datasets. We propose the next generation of EAGLE zoom simulations, called EAGLE Cosmic Origins, to model HI and low metal ions (C II, Mg II, & Si II) throughout not just the CGM but also within the galaxies themselves. We will employ a novel, new chemistry solver, CHIMES, to follow time-dependent ionization, chemistry, and cooling of 157 ionic and molecular species, and include multiple ionization sources from the extra-galactic background, episodic AGN, and star formation. Our aim is to understand the complete baryon cycle of inflows, outflows, and gas recycling traced over 10 decades of HI column densities as well as the complex kinematic information encoded low ion absorption spectroscopy. This simulation project represents a pilot program for a larger suite of zoom simulations, which will be publicly released and lead to additional publications.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Stellar Populations  
ID: 15112  
Program Title: The low-metallicity starburst NGC346: massive-star population and feedback

Principal Investigator: Lida Oskinova  
PI Institution: Universitat Potsdam

The Small Magellanic Cloud (SMC) is ideal to study young, massive stars at low metallicity. The compact cluster NGC346 contains about half of all O-type stars in the entire SMC. The massive-star population of this cluster powers N66, the brightest and largest HII region in the SMC.

We propose to use HST-STIS to slice NGC346 with 20 long-slit exposures, in order to obtain the UV spectra of most of the massive early-type stars of this cluster. Archival data of 13 exposures that cover already a minor part of this cluster will be included in our analyses.

Our aim is to quantitatively analyze virtually the whole massive-star population of NGC346. We have already secured the optical spectra of all massive stars in the field with the integral-field spectrograph MUSE at the ESO-VLT. However, for the determination of the stellar-wind parameters, i.e., the mass-loss rates and the wind velocities, ultraviolet spectra are indispensable. Our advanced "Potsdam Wolf-Rayet (PoWR)" code will be used for modeling the stellar and wind spectra in the course of the analysis.

Finally, we will obtain:
(a) the fundamental stellar and wind parameters of all stars brighter than spectral type B2V in the field, which, e.g., will constrain the initial mass function in this young low-metallicity starburst;
(b) mass-loss rates of many more OB-type stars at SMC metallicity than hitherto known, allowing to better constrain their metallicity dependence;
(c) the integrated feedback by ionizing radiation and stellar winds of the whole massive-star population of NGC346, which will be used as input to model the ecology of the giant HII region N66.

These HST UV data will be of high legacy value.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15316
Program Title: Unveiling the mysterious nature of the cataclysmic variable SDSS J153817.35 +5123238.0

Principal Investigator: Anna Pala
PI Institution: The University of Warwick

Evolution of cataclysmic variables (CVs) is driven by angular momentum loss, which keeps mass loss from the donor star continually going, replenishing the disc with new higher-momentum material and maintaining, in this way, the accretion process. The angular momentum loss rate can be accurately constrained by measuring the white dwarf (WD) effective temperature (Teff), and provides one of the best available tests for the present model of the CV evolution. We conducted an HST/COS survey (ID 12870, PI Gaensicke) in which we measured Teff for 31 CV WDs. Our results are in good agreement with the theoretical prediction with one exception: SDSS J153817.35+5123238.0, a short period (93.1 min) CV which contains an anomalously hot WD. We argue that the system is either a very young CV (~20Myr), or has been recently re-heated to ~35000K. While the former hypothesis is statistically unlikely, the latter is most likely related to a nova eruption within the past few 1000 years or to additional mechanisms of angular momentum losses that are not account for by the present theory of CV evolution. To distinguish between these three scenarios, we need higher resolution UV observation to accurately measure the white dwarf mass, its effective temperature and photospheric abundances, along with a search for absorption features due to an ejected shell and their velocity. In this way we will constrain the WD age (from an improved mass measurement), its cooling rate (from this second temperature measurement) and we will also identify possible ashes and the expanding circumstellar gas shell expected in case of a recent nova explosion, shedding light on the mysterious nature of this system.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Solar System  
ID: 15207  
Program Title: The Moons of Kuiper Belt Dwarf Planets Makemake and 2007 OR10

Principal Investigator: Alex Parker  
PI Institution: Southwest Research Institute

In two recent analyses of Hubble data, we discovered that both Makemake (the second-brightest trans-Neptunian Object behind only Pluto) and 2007 OR10 (the third largest TNO behind only Pluto and Eris) each have a faint satellite in orbit about them. With the addition of these satellites, all known TNOs with diameters unequivically larger than 1000 km are known to have moons; these are the only two for which the satellite orbits have not been characterized. The presence of these satellites provides the opportunity to accurately characterize bulk properties of Makemake and 2007 OR10 for the first time, including their masses and densities. This is a remarkable opportunity to study two of the largest dwarf planets in the solar system, completeing the census of bulk properties for TNOs with D>1000 km. Hubble has been instrumental in characterizing the satellites of the other TNO dwarf planets, as its union of sensitivity and angular resolution make it uniquely capable of studying these faint, high-contrast systems. We request an 18-orbit program to accurately measure the orbital properties of these satellites and to derive the masses and densities of Makemake and 2007 OR10. Both Makemake and 2007 OR10 are targets of JWST Guaranteed Time Observations, and this HST program is required to provide orbital phasing information that will ensure that the JWST MIRI observations can resolve the systems.
Two decades after the discovery of 51 Peg b, the formation processes of short-period gas giants remain poorly understood. Hot Jupiters are predicted to have migrated inwards by means of several possible mechanisms, including the tidal dissipation of their orbital energy. The study of highly eccentric planets allows the quantification of the tidal dissipation efficiency of hot Jupiters, shedding light into the relevant timescales to understand the formation of close-in planets.

The atmospheres of hot Jupiters also keep a part of mystery. Clouds seem ubiquitous, challenging our ability to retrieve molecular abundances from the observations. Phase curve observations allow us to map the cloud distribution on a planet, decipher their chemical composition and inform us about the conditions in the deep, usually unobservable layers of the planet.

HD80606b is a hot Jupiter in a remarkable orbit. With an eccentricity of more than 0.9, it's atmosphere heats up by a thousand degrees in a few days during periastron passage. The planet is an extremely useful laboratory to understand both tidal dissipation and the response of the atmosphere to a time-dependent forcing. From current thermal phase curve observations we think that the planet is either poorly efficient at dissipating it's energy, or is covered by a thick cloud layer.

Here we propose to break the degeneracies between the two scenarii by detecting the light reflected by the clouds during the periastron passage of the planet with WFC3/UVIS. This small HST program will also provide
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Stellar Populations
ID: 15179
Program Title: Astrophysics Meets Atomic Physics: Fe I Line Identifications and Templates for Old Stellar Populations from Warm and Hot Stellar UV Spectra

Principal Investigator: Ruth Peterson
PI Institution: SETI Institute

Imaging surveys from the ultraviolet to the infrared are recording ever more distant astronomical sources. Needed to interpret them are high-resolution ultraviolet spectral templates at all metallicities for both old and intermediate-age stars, and the atomic physics data essential to model their spectra. To this end we are proposing new UV spectra of four warm and hot stars spanning a wide range of metallicity. These will provide observational templates of old and young metal-poor turnoff stars, and the "laboratory source" for the identification of thousands of lines of neutral iron that appear in stellar spectra but are not identified in laboratory spectra.

By matching existing and new stellar spectra to calculations of energy levels, line wavelengths, and gf-values, Peterson & Kurucz (2015) and Peterson, Kurucz, & Ayres (2017) identified 124 Fe I levels with energies up to 8.4eV. These provided ~3000 detectable Fe I lines from 1600A to 5.4mu, and yielded empirical gf-values for 640 of these. Here we propose high-resolution UV spectra reaching 1780A for the first time at the turnoff, to detect and identify the strongest Fe I lines at 1800 - 1850A. This should add ~250 new Fe I levels. These spectra, plus one at lower resolution reaching 1620A, will also provide empirical UV templates for turnoff stars at high redshifts as well as low. This is essential to deriving age and metallicity independently for globular clusters and old galaxies out to z~3. It will also improve abundances of trace elements in metal-poor stars, constraining nucleosynthesis at early epochs and aiding the reconstruction of the populations of the Milky Way halo and of nearby globular clusters.
Proposition Category: GO
Scientific Category: Stellar Populations
ID: 15317
Program Title: The Low-Mass Stellar Initial Mass Function: Ultra-Faint Dwarf Galaxies Revisited

Principal Investigator: Imants Platais
PI Institution: The Johns Hopkins University

The stellar Initial Mass Function plays a critical role in the evolution of the baryonic content of the Universe. The form of the low-mass IMF - stars of mass less than the solar mass - determines the fraction of baryons locked up for a Hubble time, and thus indicates how gas and metals are cycled through galaxies. Inferences from resolved stellar populations, where the low-mass luminosity function and associated IMF can be derived from direct star counts, generally favor an invariant and universal IMF. However, a recent study of ultra-faint dwarf galaxies Hercules and Leo IV indicates a "bottom-lite" IMF, over a narrow range of stellar mass (only 0.55-0.75 M_sun), correlated with the internal velocity dispersion and/or metallicity. We propose to obtain ultra-deep imaging for a significantly closer ultra-faint dwarf, Bootes I, which will allow us to construct the luminosity function down to M_v=+10 (equivalent to ~0.35 solar mass). We will also re-analyze the HST archival observations for the Hercules and Leo IV dwarfs using the same updated techniques as for Bootes I. The combined datasets should provide a reliable answer to the question of how variable is the low-mass stellar IMF.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Galaxies and the IGM  
ID: 15180  
Program Title: ELGs in Absorption: Tracing the Cosmic Baryon Cycle from Noon til Dusk

Principal Investigator: Jason Prochaska  
PI Institution: University of California - Santa Cruz

Far beyond the visible star formation in galaxies, the circumgalactic medium (CGM) regulates the gaseous inflows and outflows that compete continuously over billions of years to drive galaxy formation and evolution. Successful programs carried out with the Cosmic Origins Spectrograph on HST have resolved the bulk baryonic content, spatial distribution, and chemical enrichment of the CGM surrounding z~0 galaxies with a diverse range of stellar masses and star formation histories. Complimentary studies with optical spectrometers on the ground have probed the CGM of star-forming galaxies and the massive galaxies hosting quasars at z~2. With this proposal, we will examine evolution (or lack thereof) in the CGM of star-forming z~1 galaxies (ELGs or emission-line galaxies) — the central focus of several major, upcoming cosmological experiments (e.g. DESI, Euclid). We have identified 25 ELGs in the foreground of 24 z~1, bright quasars that will sample the CGM of star-forming galaxies at the peak epoch of galaxy evolution, when average star formation rates were higher than today and when z ~ 0 passive galaxies were likely undergoing their quenching. With this study, we will characterize the ionization state, gas kinematics, and covering fraction of the enriched gas that will ultimately go on to form the bulk of today's visible stars. Our sample will combine with a Cycle 24 sample of Large Red Galaxies to form a systematic study of the CGM in star forming and passive galaxies and establish a 4-6 Gyr timeline in CGM/galaxy interactions.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: AR  
Scientific Category: Galaxies and the IGM  
ID: 15046  
Program Title: Cosmic Ray driven outflows and the structure of the CGM

Principal Investigator: Thomas Quinn  
PI Institution: University of Washington

The circumgalactic medium (CGM) is a dynamically complex, diffuse multiphase gas that extends to the virial radius of galaxies. The interplay in the CGM between outflows from the star-forming disk and inflows form the intergalactic medium (IGM) provides constraints to theories of galaxy formation and evolution. Due to its faint nature, the CGM is difficult to observe and has only recently been considered to play a major role in galaxy evolution. The mass structure and kinematics of the CGM are strongly influenced by galactic outflows. Recent simulations have shown that including cosmic rays (CRs) in stellar feedback prescriptions results in more effective galactic winds that better match observations compared to thermal feedback alone. Here we propose a systematic study of the effect of CR driven galactic outflows on the CGM by simulating a suite of isolated disk galaxies for which anisotropic CRs are dynamically important with the goal of reproducing the observed temperature and pressure structure of the CGM, understanding the galactic recycling process of metals, and determining the role of CR-driven outflows on star formation history.
The [O III] emission in old supernova remnants takes the form of long, crisp filaments, while the H alpha and [S II] emission is frothy and clumpy. That indicates that instabilities in cooling gas behind the shock produce strong turbulence. This very rapid generation of turbulence is not considered in the picture of global turbulence in the ISM, and it amplifies magnetic fields and boosts the energy of cosmic rays. It can also affect the overall emission spectrum of the shocked gas in ways not considered in the 1D models used to interpret spectra of SNRs, HH objects and AGN. We propose to quantify and understand the mechanism for generating turbulence by obtaining narrow band WFC3 images and STIS UV and optical spectra to complement an existing Heritage mosaic of WFC3 images of the western Cygnus Loop (Veil Nebula). This is a unique opportunity to fully characterize the post-shock flow in a supernova remnant shock because the Cygnus Loop is nearby and nearly unreddened. It is crucial both for the understanding of turbulence and for interpreting the spectra of unresolved shocks in more distant SNRs, in AGN and in HH objects.
Herbig-Haro (HH) objects are the optical manifestations of shock waves excited by outflows from young stars. They represent one of the few classes of spatially extended astronomical objects where both structural changes and proper motions can be measured on time scales of years to decades. HH 80/81 is a pair of HH objects in Sagittarius which are the intrinsically most luminous HH objects known. The driving source of HH 80/81 is the embedded star IRAS 18162-2048, which has a luminosity of 20,000 Lsun and excites a compact HII region, suggesting that it is a newborn massive star. HH objects associated with massive young stars are very rare, only a handful of cases are known, but what makes the HH 80/81 source unique among massive protostars is that it produces a finely collimated bipolar radio jet with extremely high velocity and pointing straight to HH 80/81. We propose to observe the HH-80/81 complex with WFC3 and the following four filters: Halpha 6563, Hbeta 4861, [SII] 6717/31, and [OIII] 5007. First epoch HST images were obtained 22 years ago, which now allows a very precise determination of proper motions. Groundbased optical and radio proper motions are not only uncertain, but actually contradict each other, a controversy that will be resolved by HST. The fine resolution of WFC3 allows a study of both fine structural details and structural changes of the shocks. Finally we will use a sophisticated adaptive grid code to interpret the (de-reddened) line ratios across the shocks.
Proposal Category: AR
Scientific Category: Stellar Physics
ID: 15047
Program Title: Do stellar clusters form fewer binaries? Using moderate separation binaries to distinguish between nature and nurture

Principal Investigator: Megan Reiter
PI Institution: University of Michigan

Fewer wide-separation binaries are found in dense stellar clusters than in looser stellar associations. It is therefore unclear whether feedback in clusters prevents the formation of multiple systems or dynamical interactions destroy them. Measuring the prevalence of close, bound binary systems provide a key test to distinguish between these possibilities. Systems with separations of ~10-50 AU will survive interactions in the cluster environment, and therefore are more representative of the natal population of multiple systems. By fitting a double-star PSF, we will identify visual binaries in the Orion Nebula with separations as small as 0.03". At the distance of Orion, this corresponds to a physical separation of ~12 AU, effectively closing the observational gap in the binary separation distribution left between known visual and spectroscopic binaries (>65 AU or <10 AU, respectively). To conduct this search, we will build a a code suite to determine the best-fit parameters of marginally resolved binaries, which we anticipate to being led by a graduate student as part of their PhD thesis.
Proposal Category: AR
Scientific Category: Massive Black Holes And Their Host Galaxies
ID: 15048
Program Title: Application of Independent Component Analysis to Legacy UV Quasar Spectra

Principal Investigator: Gordon Richards
PI Institution: Drexel University

We propose to apply a novel analysis technique to UV spectroscopy of quasars in the HST archive. We endeavor to analyze all of the archival quasar spectra, but will first focus on those quasars that also have optical spectroscopy from SDSS. An archival investigation by Sulentic et al. (2007) revealed 130 known quasars with UV coverage of CIV complementing optical emission line coverage. Today, the sample has grown considerably and now includes COS spectroscopy. Our proposal includes a proof-of-concept demonstration of the power of a technique called Independent Component Analysis (ICA). ICA allows us to reduce complexity of of quasar spectra to just a handful of numbers. In addition to providing a uniform set of traditional line measurements (and carefully calibrated redshifts), we will provide ICA "weights" to the community with examples of how they can be used to do science that previously would have been quite difficult. The time is ripe for such an investigation because 1) it has been a decade since the last significant archival investigation of UV emission lines from HST quasars, 2) the future is uncertain for obtaining new UV quasar spectroscopy, and 3) the rise of machine learning has provided us with powerful new tools. Thus our proposed work will provide a true UV
Proposal Category: GO
Scientific Category: Cosmology
ID: 15145
Program Title: The Hubble Constant to 1%: Physics beyond LambdaCDM

Principal Investigator: Adam Riess
PI Institution: The Johns Hopkins University

By steadily advancing the precision and accuracy of the Hubble constant, we now see 3.4-sigma evidence for a deviation from the standard LambdaCDM model and thus the exciting chance of discovering new fundamental physics such as exotic dark energy, a new relativistic particle, dark matter interactions, or a small curvature, to name a few possibilities. We propose a coordinated program to accomplish three goals with one set of observations: (1) improve the precision of the best route to H_0 with HST observations of Cepheids in the hosts of 11 SNe Ia, lowering the uncertainty to 1.3% to reach the "discovery" threshold of 5-sigma and begin resolving the underlying source of the deviation; (2) continue testing the quality of Cepheid distances, so far the most accurate and reliable indicators in the near Universe, using the tip of the red giant branch (TRGB); and (3) use oxygen-rich Miras to confirm the present tension with the CMB and establish a future route available to JWST. We can achieve all three goals with one dataset and take the penultimate step to reach 1% precision in H_0 after Gaia. With its long-pass filter and NIR capability, we can collect these data with WFC3 many times faster than previously possible while overcoming the extinction and metallicity effects that challenged the first generation of H_0 measurements. Our results will complement the leverage available at high redshift from other cosmological tools such as BAO, the CMB, and SNe Ia, and will provide a 40% improvement on the WFIRST measurements of dark energy. Reaching this precision will be a fitting legacy for the telescope charged to resolve decades of uncertainty regarding the Hubble constant.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Stellar Populations
ID: 15146
Program Title: DASHing through the LMC and M31: towards 1% distances

Principal Investigator: Adam Riess
PI Institution: The Johns Hopkins University

The star formation histories of our nearest neighbors, M31 and the LMC, have been the subjects of intensive study but the 3% to 5% uncertainty in their distance limits knowledge of the ages of their structures to 0.6 to 1.0 Gyr. Two recent developments make it possible to reach the previously unimaginable precision in distance of 1%. The first is the development of DASH, which allows HST and WFC3 to slew tens of arcminutes between exposures within an orbit under gyro control with enough precision to efficiently observe widely distributed Cepheids. The second is the arrival of parallax measurements from Gaia which are calibrating the individual distances of long period Cepheids in the Milky Way to 2%. However, bandpass and zeropoint differences between ground and space observations would compromise the precision of the Gaia parallaxes when building a Cepheid bridge to our neighbors. We propose to dash around the LMC and M31 with WFC3 to rapidly collect 3 band photometry of over 70 long period Cepheids using the same photometric system as a calibration set of Cepheids in the Milky Way. These will nullify otherwise systematic errors to extend the precision of Gaia beyond the Milky Way and clock the formation of structures in M31 and the LMC to 100 Myr.
In theoretical models of the interstellar medium, thermal instability plays a major role in segregating the neutral gas into two distinct phases in pressure equilibrium: a warm neutral medium and a cold neutral medium. Temperatures intermediate between the warm and cold phases are forbidden because at constant thermal pressure gas at such temperatures would be thermally unstable. While existing observational results on the physical conditions in interstellar clouds generally support these ideas, studies tend to disagree as to the extent of the thermally unstable component. We have recently developed a technique that allows us to simultaneously determine the densities and temperatures in interstellar clouds through the analysis of O I fine-structure excitations. Here, we propose an archival survey of the O I fine-structure lines seen in high-resolution STIS spectra of approximately 40 sight lines. We will derive the densities and temperatures that correspond to the observed O I excitation ratios at discrete velocities along each line of sight. We then use this information to construct a phase diagram for the interstellar medium for comparison with the results of theoretical models of a two-phase medium. These comparisons will serve as a basic test of the validity of such models, and will allow us to determine the extent to which the gas is (or is not) in thermal equilibrium, yielding important inputs for future modeling efforts.
Proposal Category: AR
Scientific Category: Cosmology
ID: 15050
Program Title: Turning Gravitationally Lensed Supernovae into Cosmological Probes

Principal Investigator: Justin Roberts-Pierel
PI Institution: University of South Carolina Research Foundation

Recent HST observations have been critically important for two
landmark discoveries of gravitationally lensed supernovae: the first
multiply-imaged SN, "Refsdal", and the first Type Ia SN resolved into
multiple images, SN iPTF16geu. Fitting the multiple light curves of
such objects can deliver measurements of the lensing time delays,
which in turn provide precise tests of lens models or unique
constraints on the Hubble constant and other cosmological parameters.
For both of these SNe, initial constraints on the time delays have
been limited by the need to account for subtle microlensing
effects. We will perform a complete reanalysis of both SN Refsdal and
SN iPTF16geu, in order to refine estimates of their lensing
magnifications and time delays. Our work will improve upon previous
efforts by revising the data processing and photometry, and including
the significant yet previously ignored effects of
microlensing. Additionally, we will develop a publicly available
software package in the course of this work, optimized specifically
for multiply-imaged SNe. This software will be an important tool in
the next decade, supporting precise time delay measurements of tens to
hundreds of lensed SNe to be found with LSST and WFIRST.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Massive Black Holes And Their Host Galaxies  
ID: 15081

Program Title: Revealing the circum-nuclear torus: HST imaging of active galaxies observed during a Spitzer reverberation mapping campaign

Principal Investigator: Andrew Robinson  
PI Institution: Rochester Institute of Technology

We are currently analyzing data from a recently completed ~2.5 year monitoring campaign, during which 12 low-redshift broad-line AGN were observed at 3.6 and 4.5 microns with the Spitzer Space Telescope, with supporting optical observations from several ground-based telescopes. The objective is to "reverberation map" the circumnuclear torus of dusty molecular gas that is a key element of the AGN unification scheme; that is, infer its size and structure from the temporal response of the dusty torus IR emission to changes in the AGN optical luminosity. However, a critical unknown is the contribution of host galaxy starlight to the measured optical luminosity.

The objective of this proposal is to obtain WFC3/UVIS images of 8 of our Spitzer galaxies in order to decompose the host galaxy and AGN contributions within the photometric apertures used for the monitoring campaign. Removing the host galaxy contribution is an essential step in the analysis and interpretation of this unique time-series dataset, since it will allow the intrinsic luminosity and variability amplitude of the AGN optical continuum to be determined.

This, in turn, will yield more precise measurements of the optical-IR lags and better estimates of the dust sublimation radius and undiluted
Proposal Category: GO  
Scientific Category: Massive Black Holes And Their Host Galaxies  
ID: 15082  
Program Title: Monsters on the move: Confirming gravitational wave recoiling supermassive black hole candidates  

Principal Investigator: Andrew Robinson  
PI Institution: Rochester Institute of Technology  

There is compelling evidence that supermassive black holes (SMBH) reside at the centers of all large galaxies and are the gravitational 'engines' of Active Galactic Nuclei (AGN). Mergers between galaxies are thought to have played a fundamental role in the growth and evolution of the largest galaxies in the nearby universe. Galaxy mergers lead to the formation of an SMBH binary, which eventually coalescences through the emission of gravitational waves and receives a recoil kick (~several 1000km/s). This recoil in turn causes the merged SMBH to oscillate (~1Gyr) in the gravitational potential well of the host galaxy. During this time, the recoiling SMBH may be observed as a 'displaced' AGN. These events are a strong test of gravitational physics and the merger frequency of binary SMBH. Due to the long damping time of the post recoil oscillations, displacements ~10-100pc may be expected even in nearby elliptical galaxies and can be measured as spatial offsets of AGN in high resolution optical or infrared images. In a preliminary study of 96 early type galaxies using archival HST/WFPC2 images we have identified 18 candidates that show a significant displacement between the SMBH (traced by the AGN) and the photocenter of the host galaxy, determined by isophotal analysis. However, it is necessary to confirm these displacements using IR images since diffuse galaxy scale and nuclear dust structures are common. Here we propose to obtain WFC3/IR F110W and F160W images of 6 of the 18 candidates for which no IR images are available in the HST archive. These observations will allow us to both confirm and improve the accuracy of the measured displacements.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15083
Program Title: Star Clusters in Tidal Debris: A UV Survey of Stellar Populations, Galaxy Interactions, and Evolution

Principal Investigator: Michael Rodruck
PI Institution: The Pennsylvania State University

Tidal tails afford us a unique window into the processes shaping star formation, offering an unobstructed view of the star formation environment in these outskirts. The latest galactic merger simulations are finding an unexpected increase of star formation in extended tidal debris, with 20 - 50% of the systems star formation rate occurring in these regions. We see this observationally in massive clusters forming in the Tadpole galaxy, occupying 30% of the system's star formation rate. At the same time, clusters suffer high rates of disruption, dispersing their material into the diffuse light of the tail and mixing with old stars drawn from the parent galaxies. We intend to break our tidal tails into their composite populations using HST and ground-based Gemini imaging. Our existing WFPC2 VI-band and HI data indicate clusters prefer to live in regions of high HI kinetic energy and low shear. However, analysis is limited to population studies, as the lack of UB-band data prevents us from age or mass estimates, permitting only a shallow understanding of the relationship between local HI properties and star clusters. Additionally, while the high resolution of HST is necessary for identifying and studying star clusters, it is unsuitable for the sensitive imaging needed to study the faint, diffuse tails. Our proposed 11 orbits of WFC3/ACS UB-band imaging will allow for precise age and mass measurements of our star clusters, while ground-based imaging searches the diffuse light for the cluster destruction history. In this manner, we will determine the present and past history of star formation in tidal tails, and the HI densities and kinematics required for cluster formation.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: AR
Scientific Category: Stellar Physics
ID: 15051
Program Title: A New Test of Copper and Zinc Abundances in Late-Type Stars Using Cu II and Zn II lines in the Near-Ultraviolet

Principal Investigator: Ian Roederer
PI Institution: University of Michigan

The copper (Cu, Z = 29) and zinc (Zn, Z = 30) abundances found in late-type stars provide critical constraints on models that predict the yields of massive star supernovae, hypernovae, Type Ia supernovae, and AGB stars, which are essential ingredients in Galactic chemical evolution models. Furthermore, Zn is commonly used to compare the abundance of iron-group elements in the gas phase in high-redshift DLA systems with metallicities in Local Group stars. It is thus important that the observational Cu and Zn abundances in stars are correct.

My proposed archive study will address this issue by using archive STIS spectra of 14 stars to provide the first systematic observational tests of non-LTE calculations of Cu and Zn line formation in late-type stars. The non-LTE calculations predict that all LTE [Cu/Fe] abundance ratios presently found in the literature are systematically lower than the true ratios found in stars. The non-LTE calculations for Zn predict that the LTE values in the literature may be systematically overestimated in low-metallicity stars. The LTE abundances of Cu and Zn are derived from Cu I and Zn I lines. The key advance enabled by the use of NUV spectra is the detection of several lines of Cu II and Zn II, which cannot be detected in the optical or infrared. Cu II and Zn II are largely immune to non-LTE effects in the atmospheres of late-type stars. The metallicities of the 14 stars with NUV spectra span -2.6 < [Fe/H] < -0.1, which covers the range of most Cu and Zn abundances reported in the literature. The proposed study will allow me to test the non-LTE calculations and calibrate the stellar abundances.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Massive Black Holes And Their Host Galaxies
ID: 15181
Program Title: AGN Before and After: Towards a balanced view of the connection between circumnuclear gas and nuclear black hole activity

Principal Investigator: David Rosario
PI Institution: Durham Univ.

The well-known connections between super-massive black holes and their host galaxies are set by the flow of gas through the circum-nuclear environment. We are currently undertaking a detailed study of the processes that govern these multi-phase, complex flows using deep, high-resolution VLT/SINFONI IFU data and VLT/XSHOOTER spectroscopy from the optical to the near-IR. A novel feature of our program is the uniform analysis of both luminous AGN and carefully matched inactive galaxies. This provides a comparative baseline of the relevant astrophysics with enough numbers for a statistical treatment.

An essential input to our study is the small-scale, filamentary structure of cold gas, best visible in dust maps based on multi-band imaging with the HST. Unfortunately, suitable archival imaging is greatly weighted towards the AGN in our sample, and over half of the inactive control have never been observed with HST. Here we propose to correct this imbalance through broad-band optical and NIR imaging of 21 galaxies with the HST/WFC3 camera. The combination of sensitive optical and NIR imaging and spectroscopic constraints at sub-arcsecond resolution will enable a uniquely detailed view of the circum-nuclear environment in our entire sample, with which we will study the dynamics of gaseous inflows and outflows, excitation conditions and black hole feedback with unprecedented contextual accuracy.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Stellar Populations  
ID: 15354  
Program Title: The fate of NGC602, an intense region of star-formation in the Wing of the SMC  

Principal Investigator: Elena Sabbi  

PI Institution: Space Telescope Science Institute

This is a small 2 orbit proposal designed to measure the internal dynamics of NGC602, a small region of intense star formation in the Wing of the SMC, with a low gas and dust density that has been often considered an unfavorable place for star formation. Small regions of massive star formation are important to study for our understanding of the process of star and cluster formation, the ionization of the interstellar medium, and the injection of energy and momentum into their host galaxy. By combining our new observations with archival ACS/WFC data acquired in July 2004, we will be able to measure the relative proper motions of the NGC602 sub-structures better than 2.3 km/s and investigate the nature of the apparently isolated massive stars found around NGC602. This study will provide unique observational data to characterize the early phase of cluster evolution and test cluster formation theories. It will also address significant open issues in star formation, cluster dynamics and the origin of isolated supernovae and GRBs.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Cosmology  
ID: 15113  
Program Title: Extending the DA white dwarf spectrophotometric network to the Southern Hemisphere

Principal Investigator: Abhijit Saha  
PI Institution: National Optical Astronomy Observatory, AURA

Photometric calibration uncertainties are the dominant source of error in current type Ia supernova dark energy studies, and other forefront cosmology efforts, e.g., photo-redshifts for weak lensing mass tomography. Modern 'all-sky' surveys require a network of calibration stars with 1) known SEDs (to properly and unambiguously account for filter differences), and 2) that are on a common photometric zero-point scale. HST enables us to establish this essential network of faint spectrophotometric standards by eliminating the time-variable Earth's atmosphere, and by exploiting the well-understood energy distributions of hot DA white dwarfs (DAWDs). Broadband HST photometry, together with ground-based Balmer line spectra, are used to derive their atmospheric model parameters (temperature & surface gravity), set the overall flux scale for each source, and determine any applicable reddening. Stars thus calibrated can be used as flux standards in any arbitrary (but well characterized) passband. From data in prior HST cycles, we have calibrated 13 DAWDs between 16.5 and 19.5 mag (in V) to sub-percent accuracy spread over the equatorial and northern sky. We now have a well appraised set of targets spanning the southern sky, where suitably faint bona-fide DAWDs were not previously available. HST/WFC3 photometry of these new targets will fill the southern void, especially relevant for LSST. This precision all-sky photometric heritage from HST benefits essentially all existing and upcoming surveys, standardizes (spectro)photometry across observatories and facilities, and directly addresses one of the current barriers to understanding the nature of dark energy.
Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15208
Program Title: Star-Formation in Free-Floating Evaporating Gaseous Globules

Principal Investigator: Raghvendra Sahai
PI Institution: Jet Propulsion Laboratory

We propose to study the stellar embryos in select members of a newly recognized class of Free-floating Evaporating Gaseous Globules (frEGGS) embedded in HII regions and having head-tail shapes. We discovered two of these in the Cygnus massive star-forming region (MSFR) with HST, including one of the most prominent members of this class (IRAS20324). Subsequent archival searches of Spitzer imaging of MSFRs has allowed us to build a statistical sample of frEGGs. Our molecular-line observations show the presence of dense molecular cores with total gas masses of (0.5-few) Msun in these objects, and our radio continuum images and Halpha images (from the IPHAS survey) reveal bright photo-ionized peripheries around these objects.

We hypothesize that frEGGs are density concentrations originating in giant molecular clouds, that, when subject to the sculpting and compression by strong winds and UV radiation from massive stars, become active star-forming cores. For the 4 frEGGs with HST or near-IR AO images showing young stars and bipolar cavities produced by their jets or collimated outflows, the symmetry axis points roughly toward the external ionizing star or star cluster - exciting new evidence for our overpressure-induced star formation hypothesis. We propose to test this hypothesis by imaging 24 frEGGs in two nearby MSFRs that represent different radiation-dominated environments. Using ACS imaging with filters F606W, F814W, & F658N (Halpha[NII]), we will search for jets and outflow-excavated cavities, investigate the stellar nurseries inside frEGGs, and determine whether the globules are generally forming multiple star systems or small clusters, as in IRAS20324.
The carbon star V Hya is experiencing heavy mass loss as it undergoes the transition from an AGB star to a planetary nebula (PN). This is possibly the earliest object known in this brief phase, which is so short that few nearby stars are likely to be caught in the act. Molecular observations reveal that a bipolar nebula has been established even at this early stage.

Using STIS, we obtained high spatial-resolution long-slit optical spectra of V Hya spanning 3 epochs spaced apart by a year during each of two periods (2002-2004, 2011-2013). These data reveal high-velocity emission in [SII] lines from compact blobs located both on- and off-source, with the ejection axis executing a flip-flop, both in, and perpendicular to, the sky-plane. We have proposed a detailed model in which V Hya ejects high-speed (200-250 km/s) bullets once every 8.5 yr associated with periastron passage of a binary companion in an eccentric orbit with an 8.5 yr period. We suggest that the jet driver is an accretion disk (produced by gravitational capture of material from the primary) that is warped and precessing. Our model predicts the locations of previously ejected bullets in V Hya and future epochs at which new bullets will emerge. We now propose new STIS observations of these remarkable bullet ejections over two new epochs well separated from previous ones, to robustly test our model. The proposed observations will provide us with an unprecedented opportunity to look on as V Hya's circumstellar envelope is sculpted by these bullets. Our study will help solve the long-standing puzzle of how the spherical mass-loss envelopes of AGB stars evolve into bipolar and multipolar PNe.
A significant fraction of the mass of an old stellar population should be in the form of isolated black holes (BHs). Yet there has never been an unambiguous detection of a solitary BH. The only technique available to detect isolated BHs is astrometric microlensing—relativistic deflection of light from background stars.

We have carried out 2 HST programs aimed at the first detection of isolated BHs through astrometric microlensing. Our first program was a multi-year program where we monitored 5 microlensing events with T>100 days in the Galactic bulge. We detected astrometric deflections, but the infered masses for all these events are <0.5 Msun, indicating that these lenses are low-mass stars with small relative proper motions. Our second program was a large multi-cycle program where we monitored ~3 million stars in the Galactic bulge for 3 years to simultaneously detect microlensing events and determine their astrometric shifts. We have detected a large number of microlensing events. However, once again, none of them show appreciable astrometric deflections indicative of massive BHs.

Our results imply that either isolated BHs are more massive (>10 Msun), or T~100 day events are dominated by low-mass stars moving more slowly, or BHs are much rarer. BHs with mass > 10 Msun are expected to have T>300 days, and such very-long duration events are extremely unlikely to be caused by low-mass stars. Monitoring a few T>300-day events thus offers the last but most promising opportunity to detect isolated BHs, and distinguish between the above possibilities. After the recent upgrades, OGLE detects six T>300 days events each year, here we propose to monitor 4 such events.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15114
Program Title: Star cluster formation in extreme environments: an isolated pair of closely interacting dwarf galaxies

Principal Investigator: Ruben Sanchez-Janssen
PI Institution: Royal Observatory Edinburgh

We have identified a nearby pair of closely interacting dwarf galaxies that host a population of candidate young massive clusters (YMCs). The strong interaction has triggered nearly coeval galaxy-scale starbursts, with a delay time of only ~100 Myr from one galaxy to the other. It has also altered their stellar structure and content, as indicated by the presence of prominent tidal features, some of which host YMCs. Here we propose to carry out a UV-to-optical imaging survey of the system with WFC3/UVIS. We will take advantage of HST’s unrivalled resolution and sensitivity to detect and characterize the star cluster population in each of the two interacting dwarf galaxies. The proposed multiband photometry will be instrumental to determine ages, masses and sizes of the YMCs, as well as to provide a robust characterization of the underlying host galaxy—thus allowing for an investigation of the cluster formation efficiency in a gas-rich, high-density, metal-poor environment very reminiscent of the existing conditions at high redshift.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Stellar Populations
ID: 15182
Program Title: The Origin of Ultra-Faint Galaxies

Principal Investigator: David Sand
PI Institution: Texas Tech University

We request 24 orbits of HST/ACS to obtain imaging in F606W and F814W of apparent tidal features in two ultra-faint dwarf galaxies: Hercules and Leo V. This will enable us to test whether the stars in ultra-faint galaxies—as a population—have been affected by Galactic tides. Most of the new dwarfs show signs of tidal interaction in ground-based photometry, several have measured ellipticities greater than ~0.5, and kinematics of a subset show velocity gradients. These ubiquitous hints for tidal effects among distant dwarfs is particularly surprising and suggestive. If most ultra-faint dwarfs are disturbed by tides, then recent tests of galaxy formation in the near field have unstable foundations.

HST resolution provides an opportunity to assess whether tidal features (accompanied by tentative kinematic gradients) seen in ground-based observations of Hercules and Leo V are genuine or are instead clumps of compact background galaxies masquerading as stellar debris. In Hercules, a further test is possible: searching for a distance gradient along the stretched body of the galaxy. Parallel pointings will sample similar dwarf-centric radii away from the tidal features, assuring an unambiguous result. Whether we confirm or rule out the presence of stellar loss in these objects, the consequences are important—the origin of the ultra-faint dwarfs tells us the lower limit to both galaxy formation and the number of dark matter subhalos inhabiting the Milky Way.

This program is only possible with HST: its exquisite resolution can separate compact galaxies from main sequence dwarf stars at faint magnitudes, which even the best multi-band ground-based schemes struggle with.
Proposal Category: GO
Scientific Category: Stellar Populations
ID: 15183
Program Title: An emerging population of stripped, but isolated, stellar systems in the Virgo Cluster

Principal Investigator: David Sand

PI Institution: Texas Tech University

We have recently uncovered a unique dwarf-like galaxy in the Virgo Cluster: a diffuse, low mass system with solely young stellar populations located at least 350 kpc from the nearest massive galaxy. We hypothesize that this galaxy may be formed from ram pressure stripped gas, making it distinct from other, similar systems such as tidal dwarfs.

We request 10 orbits of HST/ACS to image a well-defined sample of five similar objects in Virgo which we postulate may also be "ram pressure dwarfs." This data will allow us to measure the basic physical properties of this emerging class of objects, including their structure, luminosity, and star formation history. HST data is also needed to constrain any old stellar population; if present, it would be indicative of a standard dwarf galaxy origin rather than newly formed stars from stripped gas. With these observations we will better understand the fate of stripped gas in the cluster environment, and test whether we have uncovered a new class of isolated stellar systems formed through cluster interactions.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Massive Black Holes And Their Host Galaxies  
ID: 15247  
Program Title: Low redshift Lyman-alpha blobs

Principal Investigator: Mischa Schirmer  
PL Institution: Gemini Observatory, Southern Operations

Lyman-alpha blobs (LABs) are luminous nebula at redshifts of 2 and beyond. Their nature and ionization sources have remained mysterious. The lack of accessible diagnostic emission lines and the poorly understood Lyman-alpha escape mechanism have so far prevented a consistent physical picture of LABs. We suggest that many LABs harbor transient AGN that have recently and quickly faded from our view; the Ly-alpha photons from the earlier quasar phase, however, are resonantly scattered and slowly released over times much longer than the LABs' light crossing time. These ionization echoes naturally explain the severe power deficits observed in LABs. We have identified a rare population of ultra-luminous [OIII] ionization echoes around transient AGN at redshifts z=0.3. They share many characteristics of LABs, including high Lyman-alpha luminosities of up to 7e43 erg/s as suggested by GALEX FUV images. We ask to observe three targets to verify the strong Lyman-alpha emission using ACS/SBC. This would prove that LABs may still exist in the Universe 7 billion years later than most other LABs known. It would also show that fading AGN explain the power deficits of many LABs, solving a puzzle that has been standing for nearly two decades. In combination with our existing ground-based imaging and 3D spectroscopy, and soft-and hard X-ray data, we will exploit the HST far-UV data to also study the Lyman-alpha escape mechanism. This proposal is a continuation of our cycle 24 allocation, to complete the far-UV data for the most luminous LABs in our sample. This proposal exploits the unique far-UV capabilities of HST.
Proposal Category: GO
Scientific Category: Solar System
ID: 15147
Program Title: Extreme Doppler Shifting of Io's Neutral Jets

Principal Investigator: Carl Schmidt
PI Institution: Boston University

The dynamics and the extension of Jupiter's magnetosphere are determined by the massive internal plasma sources combined with the fast rotation. The vast majority of the plasma originates from the atmosphere of the moon Io, the most volcanically active body in our solar system. Here we propose to characterize the density and velocity of energetic neutral atoms escaping from Io's atmosphere. Exploiting the high resolution and sensitivity of the COS G130M spectral mode, we will measure the Doppler velocities of atomic O, S and Cl streams, which are energized through charge exchange and dissociative recombination of molecular ions. Prior COS observations of Io revealed a large number of emission lines from several ion and neutral species with excellent S/N, obtained over a single HST orbit. Those spectra were obtained surrounding eclipse geometry, where Doppler shifts are minimized and were restricted to Io itself rather than the stream region. Here we will target the extended clouds with only two orbits total when the moon is at eastern and western elongation for maximum Doppler shifts. The observations will provide new constraints on the diffuse large-scale cloud structures in the Jovian system and significantly improve our understanding of the transport of mass and energy within the Io-torus interaction. The absolute brightness, in combination with plasma parameters from line ratios/collision strengths, will allow us to quantify the outflow of energetic neutral atoms from Io's main sulfur-oxygen atmosphere for the first time.
Recent discoveries of potentially habitable planets around low-mass stars have highlighted the need for a comprehensive understanding of the radiation environments in which such planets reside. Of particular importance is knowledge of the FUV radiation, as low-mass stars are typically much more active than solar-type stars and the proximity of their habitable zones (HZs) can be one tenth the distance. Such radiation has the potential to strip away a planet's atmosphere and alter its photochemistry. The vast majority of the flux emitted by low-mass stars at FUV wavelengths occurs in the Lyman-alpha line at 1216 Angstroms. However, measuring a low-mass star's direct Lyman-alpha emission is almost always impossible because of the contaminating effects of interstellar hydrogen and geocoronal airglow. By focusing on two stars with very large radial velocities (>150 km/s), emission due to Lyman-alpha will be Doppler shifted away from the contaminating sources allowing for rare opportunities to measure the intrinsic Lyman-alpha emission for K and M stars. Such observations will be vital for empirically guiding UV upper-atmosphere models of low-mass stars and for informing us how accurate reconstructed Lyman-alpha emission and correlations from other UV diagnostic lines are for known planet hosts. We have identified the only K and M dwarfs for which a complete and accurate measurement of Lyman-alpha line profile is possible.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Stellar Physics  
ID: 15210  
Program Title: The extremes of protostellar jets: Resolving the hot jet of Sz 102

Principal Investigator: Christian Schneider  
PI Institution: Universitat Hamburg, Hamburger Sternwarte

Jets and outflows from young stellar objects are a fundamental ingredient of star formation. Studies of these jets focused mainly on low temperature plasma tracers (T~1e4 K). However, there is increasing evidence for a new jet component at much higher temperatures unpredicted by theory. In particular, the jet of the classical T Tauri star DG Tau shows stationary X-ray emission (T>1e6 K plasma) close to the driving source that is mirrored in intermediate temperature C IV emission (T~1e5 K plasma). Several other sources show jet emission from highly ionized species resembling various aspects of the well studied DG Tau system. Different models were developed that explain individual systems, but do not provide a comprehensive picture that can be generally applied.

We propose STIS long-slit spectroscopy to characterize the spatial distribution and kinematics of the intermediate temperature jet of Sz 102. The Sz 102 jet shines even brighter in 1e5 K plasma tracers than the famous DG Tau jet. The proposed observations allow us to study similarities and differences between Sz 102 and DG Tau as well as to test various models that predict different spatial morphologies. The proposed observations allow us to check if the intermediate/high temperature jet plasma is caused by a general process that has been overlooked in previous studies tracing only the low temperature part of these jets.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Massive Black Holes And Their Host Galaxies
ID: 15319
Program Title: The HST View of Was 49b: An Overmassive AGN in a Merging Dwarf Galaxy?

Principal Investigator: Nathan Secrest
PI Institution: Naval Research Laboratory

Galaxy interactions are ubiquitous and play a fundamental role in the evolution of galaxies and their supermassive black holes (SMBHs). While major galaxy mergers (M1/M2~1) often trigger accretion onto both SMBHs and enhance AGN activity, the influence of minor mergers (M1/M2<1/3) on AGN fueling is poorly understood, although there is evidence that minor mergers predominantly trigger AGN activity in the primary galaxy. The dual AGN system Was 49, by contrast, is a unique system composed of a dwarf galaxy in a minor (M1/M2~1/10) merger with a disk galaxy in which the dwarf galaxy hosts a heavily obscured AGN with a luminosity of over 10^45 erg/s, while the AGN in the primary galaxy is over one thousand times less luminous. Furthermore, the black hole powering the AGN in the dwarf galaxy is much larger than black hole/galaxy scaling relations predict, with a mass of over 2% that of the stellar mass of its host. While the stellar host of this powerful AGN has been identified, the low spatial resolution of ground-based observations has limited our ability to determine the nature of this strange object. High-resolution continuum and narrow-band imaging of Was 49 is critical to understanding how such a powerful AGN could exist in a such a low mass host galaxy, as well as how this AGN is affecting its environment. Only Hubble has the resolving power and the filtering capability to determine the structure of this dwarf galaxy and the effect that the powerful AGN it hosts is having on it. This study will yield key insights into how large black holes grow in low mass galaxies, the role of minor mergers on SMBH fueling, and the effect of AGN 'feedback' before merger coalescence.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Galaxies and the IGM  
ID: 15287  
Program Title: The Path Forward for Lyman-Continuum Studies at z~3

Principal Investigator: Alice Shapley  
PI Institution: University of California - Los Angeles

Escaping Lyman-continuum (LyC) radiation from star-forming galaxies is likely responsible for the reionization of the universe. However, the direct measurement of escaping LyC radiation has proven exceptionally challenging, with only a few robust LyC detections at z~3, the highest redshift at which such measurements are possible. The tiny sample size of confirmed LyC sources hinders efforts to estimate the average LyC escape fraction and trace how its value depends on other galaxy properties -- both crucial for estimating the contribution of galaxies to reionization at z>6. To understand the LyC properties of distant galaxies, we must assemble a significantly larger sample of candidate LyC leakers and subject them to rigorous vetting for foreground contamination. Based on deep Keck/LRIS spectroscopy of 124 z~3 star-forming galaxies, we have identified 15 galaxies with apparent detections of LyC radiation. We now require HST imaging to remove any low-redshift contamination on an object-by-object basis, connect the ionizing and non-ionizing properties of LyC leakers, and compare the spatially-resolved stellar populations and morphologies of LyC detections and non-detections. We propose for 87 orbits of deep ACS/F606W, WFC3/F125W and WFC3/160W observations, providing multi-band coverage for the 14 LyC detections lacking HST data, as well as a control sample of 26 galaxies with deep Keck/LRIS spectra and LyC non-detections, and 37 additional galaxies spectroscopically confirmed at z~3. Analysis of these data will robustly remove low-redshift contaminants, revealing the connection between LyC leakage and galaxy properties both at z~3 and during the epoch of reionization.
All of the largest Kuiper Belt Objects have relatively small, close-in satellites. These satellites are likely produced by direct collisions on the primaries surface and show Earth-Moon forming impacts are likely the norm of planet formation. We recently discovered the ninth intrinsically brightest KBO, 2013 FY27, likely making it one of the top 10 largest KBOs. The largest 15 KBOs have been searched for satellites using HST, with 11 of those found to have satellites. Knowledge of a satellite are important for determining the density and thus internal structure of the KBO as well as its collisional history. 2013 FY27 is extra interesting because its size is likely in the transition region. The largest several KBOs seem to have higher densities than smaller KBOs as well as show abundant signs of water ice and methane ice. In addition, all the KBOs that are likely larger than 2013 FY23 have known satellites, except for Sedna, while the smaller KBOs satellites are not as prevalent. We propose to search for satellites of 2013 FY27 for the first time with deep, high resolution imaging to see if this transition sized dwarf planet has a satellite, which can further constrain its density.
Proposal Category: GO
Scientific Category: Massive Black Holes And Their Host Galaxies
ID: 15084
Program Title: Hot Photons: Measuring the Ionizing Continuum and EUV Emission Lines of Quasars

Principal Investigator: J. Shull

PI Institution: University of Colorado at Boulder

After two decades of uncertainty, it is now possible to characterize the ionizing spectra of QSOs, using HST/COS observations of intermediate-redshift AGN. To construct a reliable composite AGN spectrum in the rest-frame EUV requires correcting for IGM absorption, identifying prominent broad emission lines, and fitting the underlying continuum. We propose to complete the observations of the last seven AGN (at z = 1.67 - 2.18) from a sample of 20 bright intermediate-redshift QSOs. Using the broad-band (1120-2150 Å) COS/G140L grating, we will probe the rest-frame continuum and emission lines down to 350-450 Angstroms at these redshifts. Completing this sample will increase the number of AGN-EUV spectra from 3 to 10 at z > 1.67 and significantly improve the statistical reliability of the AGN composite spectrum between 400-600 Å. Lyman continuum photons from AGN dominate the metagalactic background and photoionization of hydrogen, helium, and many metal ions. They also provide key correction factors needed to determine the baryon content and metallicities of intergalactic and circumgalactic gas. The harder photons also have important effects on IGM heating and for the He II epoch of reionization. Constraints on EUV spectral turnovers below 600 Angstroms are potential diagnostics of the thermal structure of AGN accretion disks.
Proposal Category: GO
Scientific Category: Massive Black Holes And Their Host Galaxies
ID: 15115
Program Title: Emergence of the supermassive black hole - galaxy mass relations at z > 1

Principal Investigator: John Silverman
PI Institution: University of Tokyo

Our aim is to establish, for the first time in an unbiased manner, whether local fundamental relations between the mass of supermassive black holes (SMBHs) and that of their host galaxies (M_BH vs. L_host, M_BH vs. M_stellar) evolve with cosmic time. We will answer one of the outstanding key questions in astrophysics, "Are galaxies built up around the massive potential wells of mature SMBHs or does the growth pathway of galaxies precede that of their central SMBH?" Current simulations predict a strong evolution in the M_BH vs. L_host relation with SMBHs more massive by 0.5 dex at z~1.4 as compared to z=0. To test this, we have constructed a uniformly-selected sample of broad-line AGN in deep survey fields with black hole mass estimates (7.5<log M_BH<8.5) falling below the knee of the black hole mass function (significantly reducing biases) and derived from Balmer lines (i.e., Halpha), the same virial mass indicator used for calibrating local relations thus further lessening biases. We request to use HST/WFC3 to measure the total stellar mass of 36 AGN host galaxies at 1.2<z<1.7 (4x current samples), in the rest-frame V/R-band using F125W and F140W filters (dependent on the target). This sample size is required to be sensitive to an offset in the mass relations of >=0.23 dex to confirm (or rule out) the expected evolution. To date, no effort has been achieved with HST to measure the stellar mass of broad-line AGN hosts with black hole masses at intermediate levels and having sufficient statistics at z>1. We will also measure the scatter in the mass relations at early epochs thus constraining the strength of coupling between black holes and their hosts.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15085
Program Title: Galaxies in the Diffuse Baryon Field Approaching Reionization: A Joint Study with JWST, HST, and Large Telescopes

Principal Investigator: Robert Simcoe
PI Institution: Massachusetts Institute of Technology

Our team is conducting a dedicated survey for emission-line galaxies at $5 < z < 7$ in six fields containing the best and brightest $z > 6$ quasars, using JWST/NIRCAM's slitless grism in a 110 hour GTO allocation. We have acquired deep near-IR spectra of the QSOs, revealing multiple heavy-element absorption systems and probing the HI optical depth within each object's survey volume. These data will provide the first systematic view of the circumgalactic medium at $z > 4$, allowing us to study early metal enrichment, correlations of the intergalactic HI optical depth with galaxy density, and the environment of the quasar hosts. These fields generally do not have deep multicolor photometry that would facilitate selection of broadband dropout galaxies for future observation with JWST/NIRSPEC. However during long spectroscopic integrations with NIRCAM's long channel we will obtain deep JWST photometry in F115W and F200W, together with F356W for wavelength calibration. Here we request 30 orbits with HST/ACS to acquire deep optical photometry that (together with the JWST IR bands) will constrain SED models and enable dropout selection of fainter objects. For lower redshift objects the rest-UV ACS data will improve estimates of star formation rate and stellar mass. Within a Small-GO program scope we will obtain sensitivity similar to CANDELS-Deep in all six fields, and approximately double the size of our galaxy sample appropriate for JWST/NIRSPEC followup at redshifts approaching the reionization epoch.
Timing thick disk formation: an indirect census of stellar kinematics to z~2 from legacy Hubble imaging

Timing the assembly of kinematic structure in disk galaxies like the Milky Way is critically important for constraining models of galaxy evolution. We propose a novel study to indirectly measure the stellar velocity dispersion in disk galaxies back to z~2 using only Hubble imaging. We accomplish this by combining measurements of stellar scale heights from a sample of edge-on disks with stellar mass surface density maps from a sample of face-on disks. These samples are matched in redshift, mass and size. The typical stellar velocity dispersion is the direct product of these two measurements. This will provide the first census of stellar kinematics over such a large period in cosmic time, which will be used to place constraints on thick disk formation models. This proposal is uniquely suited for, and only made possible by, the high-resolution capabilities of Hubble and takes advantage of the wealth of archival HST/ACS-WFC3 data available through the legacy CANDELS survey. All of the data products and analysis software generated through this work will be released to the community.
Proposal Category: GO
Scientific Category: Planets and Planet Formation
ID: 15288
Program Title: How small and how high? Enabling UV exoplanet cloud and exosphere science with WFC3/UVIS

Principal Investigator: David Sing

PI Institution: University of Exeter

Progress on addressing two important exoplanet science topics can be made in the near-UV, where transit spectroscopy can measure aerosol scattering from the lower atmosphere, while large atmospheric escape signatures can be detectable in narrow-bands centred around strong Mg and Fe lines. WFC3/UVIS has never been used nor verified for high photometric precision transit observations, though it has the highest throughput among all HST near-UV instruments, making it an important instrument to develop for UV exoplanet science.

This program targets the ultra-hot Jupiter HAT-P-41b to measure both the broadband near-UV transmission spectra, and the narrowband escaping atmosphere signatures of Mg. Recent WFC3/IR observations show strong evidence for aerosol haze in HAT-P-41b covering a near-IR H2O feature, making it an ideal target to study near-UV aerosol properties at high altitude. By measuring how high in the atmosphere near-UV scattering signatures can be seen, important constraints can be made on both cloud aerosol sizes and atmospheric vertical mixing rates; both critical parameters needed to explain how exoplanet clouds are suspended to high altitudes. In addition, the strong estimated atmospheric escape rates in HAT-P-41b also make it an ideal target to detect hydrodynamical escape signatures of Mg. Our pilot program will demonstrate the exoplanet capabilities of WFC3/UVIS, expanding Hubble's unique UV access with a potential to probe hundreds of exoplanets.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15184
Program Title: The SN Ia Candidate T Pyxidis: Is The Accretion Rate Declining?

Principal Investigator: Edward Sion
PI Institution: Villanova University

T Pyx is a recurrent nova that unexpectedly went into outburst in 2011. It appears to have declined to its quiescent level accreting at a very high rate, possibly driven by irradiation of the donor star by the hot white dwarf or by the hot inner disk. Our team (Godon et al. 2014) has shown, using the light echo distance of 4.8kpc (Sokoloski et al. 2013), that the white dwarf in T Pyx is actually growing in mass and might be on its way to exploding as a Type Ia supernova. However, our most recent COS spectrum reveals that the flux decline continues and, in fact, has actually fallen to a flux level that is 25% below the FUV flux levels observed with IUE between 1981 and 1996, following the 1966 outburst. Moreover, a new strong emission line (Si III + O I) and strong, broad N V (1238, 1242) absorption line appear, not detected in any prior FUV spectra of T Pyx.

We propose to continue spectroscopic observations of T Pyx with HST COS during cycle 25, to obtain the first FUV spectra in early quiescence (only six years after its 44 years-delayed outburst). The first FUV spectra of T Pyx following its 1967 outburst were a full 13 years later, in 1980, when IUE was launched. By obtaining FUV COS spectra of T Pyx during cycle 25, we will detect further changes, if any, in the continuum slope, in the velocity widths and intensities of the emission lines. We will use our suite of modeling codes to study the evolution of the accretion disk. Our analysis will yield the accretion rate, and help determine whether the WD increases its mass to reach the Chandrasekhar limit. Our observations will solidify the identification of recurrent novae as Type Ia Supernova Progenitors.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Stellar Populations  
ID: 15116  
Program Title: Very Massive Stars in the Local Universe

Principal Investigator: Linda Smith  
PI Institution: Space Telescope Science Institute - ESA

The upper mass limit for stars is unknown. Recent UV observations of young (< 3 Myr), massive star clusters (>5 x10^4 M_sun) suggest that stars substantially more massive than 100 M_sun exist. These very massive stars (VMS) are not properly accounted for in current stellar population synthesis (SPS) codes, even though they will dominate the ionization and mechanical feedback in star-forming regions for the first few Myr. VMS have been detected as resolved stars in the nearby LMC cluster R136 and in the integrated light of two young super star clusters in two nearby starburst galaxies. Since JWST will obtain numerous UV rest-frame spectra of young high redshift galaxies, it is essential that we investigate whether VMS are common in local, low metallicity analogs, while we still have access to the UV domain.

We propose to obtain FUV STIS spectroscopy of young (< 3 Myr) super star clusters in 4 starbursting galaxies with the aim of establishing if VMS are commonly formed in dense star-forming events at low metallicity. The crucial spectral diagnostics for VMS are only available in the FUV, and we will use the spectroscopy together with new SPS models to constrain the upper mass limit to the initial mass function, and to test the importance of VMS for feedback. These spectra will form an important part of the UV legacy of HST and will provide an excellent local-universe analog to the rest-frame UV spectra of high-z galaxies to be obtained with JWST.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15289
Program Title: Imaging Shock Fronts in the Outer Ejecta of Eta Carinae

Principal Investigator: Nathan Smith
PI Institution: University of Arizona

Although Eta Car has been imaged many times with HST to monitor the central star and the bright Homunculus Nebula, we propose the first WFC3 imaging of Eta Car to study the more extended "Outer Ejecta" from previous eruptions. WFC3 has two key filters that have not been used before to image Eta Car, which will provide critical physical information about its eruptive history: (1) F280N with WFC3/UVIS will produce the first Mg II 2800 image of Eta Car, the sharpest image of its complex Outer Ejecta, and will unambiguously trace shock fronts, and (2) F126N with WFC3/IR will sample [Fe II] 12567 arising in the densest post-shock gas. Eta Car is surrounded by a bright, soft X-ray shell seen in Chandra images, which arises from the fastest 1840s ejecta overtaking slower older material. Our recent proper motion measurements show that the outer knots were ejected in two outbursts several hundred years before the 1840s eruption, and spectroscopy of light echoes has recently revealed extremely fast ejecta during the 1840s that indicate an explosive event. Were those previous eruptions explosive as well? If so, were they as energetic, did they also have such fast ejecta, and did they have the same geometry? The structure and excitation of the Outer Ejecta hold unique clues for reconstructing Eta Car's violent mass loss history. The locations of shock fronts in circumstellar material provide critical information, because they identify past discontinuities in the mass loss. This is one of the only ways to investigate the long term (i.e. centuries) evolution and duty cycle of eruptive mass loss in the most massive stars.
Proposal Category: GO
Scientific Category: Stellar Populations
ID: 15086
Program Title: Age and mass of the star cluster around the intermediate-mass black hole HLX-1

Principal Investigator: Roberto Soria

PI Institution: Curtin University

We propose to study the optical counterpart of the intermediate-mass black hole (IMBH) HLX-1, about 3 years after its last X-ray outburst. Previous HST observations taken at epochs closer to an outburst show a variable near-UV/blue component, plus a constant red/near-IR component. The redder component probably comes from an old stellar population around the black hole; the bluer component may be a combination of emission from an irradiated accretion disk, and from a young stellar population. Their relative contributions and the age of the stellar population(s) are still subject of debate. By re-observing the system when the irradiated component is minimal, we will determine whether the near-UV/blue optical emission has declined even further and whether the red/near-IR optical emission has stayed approximately constant. This will tell us whether the optical counterpart is a massive star cluster, and place a strong upper limit to the young stellar population around the IMBH. Having determined the constant contribution of the stellar emission, we will then insert it into broad-band models of the emission in outburst, and obtain a better estimate of the accretion disk parameters, constraining formation and evolution scenarios for the IMBH. We will use the same set of filters as in previous HST observations, for direct comparison of brightness and colors: F140LP (ACS SBC); F300X, F336W, F390W, F555W, F621M, F775W (WFC3 UVIS); F105W, F160W (WFC3 IR). We request a total of 7 orbits.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: AR  
Scientific Category: Stellar Physics  
ID: 15053  
Program Title: 3D magneto-hydrodynamic simulations of disk winds from massive protostars

Principal Investigator: Jan Staff  
PI Institution: University of the Virgin Islands

We propose to carry out magneto-hydrodynamic simulations of disk winds from accreting massive protostars. This process is likely to be one of the most important feedback processes during both low and high-mass star formation, especially controlling the star formation efficiency from the initial gas core and thus helping to set the stellar initial mass function. Also these outflows and their associated jets are important diagnostics that can test star formation theories. We will compute synthetic continuum and emission lines (Pa-beta, [FeII] and Br gamma) maps of the simulations to compare directly with observations from the HST and possible future observations by the JWST.
Proposal Category: SNAP  
Scientific Category: Stellar Physics  
ID: 15211  
Program Title: Carbon in dusty, compact Galactic planetary nebulae: A study of AGB evolution and recycling in the Milky Way  
Principal Investigator: Letizia Stanghellini  
PI Institution: National Optical Astronomy Observatory, AURA

We propose a snapshot survey of compact Galactic planetary nebulae (PNe) to acquire their UV spectra, with the aim of determining their gas-phase carbon abundances. Planetary nebulae are major cosmic recyclers, and their carbon content is essential to constrain the models of Asymptotic Giant Branch (AGB) evolution. There is an observed correlation between the gas and dust components of PNe in the Magellanic Clouds, but such a relation cannot yet be established for Galactic PNe given the lack of gas-phase carbon abundances of PNe whose dust composition is known. With our program we will measure carbon abundances for a set of compact Galactic PNe previously imaged with the HST cameras, whose dust content is known from IR/Spitzer spectral analysis, and whose ground-based optical spectra are also available from ancillary data sets. We plan to study carbon abundances of Galactic PNe in the framework of the yields from AGB evolution, especially with recent models that include dust evolution. Finally, we will compare the results of the Galactic study with similar studies based on LMC and SMC PNe, to gain insight of AGB evolution at different metallicities.
Proposal Category: GO
Scientific Category: Planets and Planet Formation
ID: 15148
Program Title: Tracing Interactions of a Protoplanet with its Circumstellar Disk

Principal Investigator: Karl Stapelfeldt
PI Institution: Jet Propulsion Laboratory

A candidate companion to a very young star has been discovered in HST snapshot optical images. The object is projected at the outer radius of an edge-on protoplanetary disk and is aligned with the disk plane. Keck LGS photometry results indicate the object has the same temperature as brown dwarf GQ Lupi b but with 10x less luminosity - consistent with a planetary mass companion. Because the edge-on disk suppresses the light of the central star, the companion is uniquely accessible to follow-up studies with minimal starlight residuals. We propose HST/WFC3 imaging and spectroscopy of the system to 1) fully define the morphology of the disk scattered light, particularly at the disk outer edge near the companion; 2) search for Halpha emission from the companion as evidence that it is actively accreting; and 3) complete spectral characterization of the companion using G141 spectroscopy. Confirmation of a substellar spectrum, accretion, and disk interaction action would establish this object as a leading example of an accreting protoplanet at 100 AU and offer support to models for planet formation by gravitational instability.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15185
Program Title: Extreme Wolf-Rayet Galaxies with HST/COS: Understanding CIII] Emission in the Reionization Era

Principal Investigator: Daniel Stark
PI Institution: University of Arizona

The first deep spectra of reionization-era galaxies have revealed strong UV nebular emission in high-ionization lines. This is in striking contrast to massive galaxies at lower redshifts, where emission from CIII], OIII], HeII, and CIV is rarely seen. These lines will likely be the only probe available for the most distant galaxies JWST will detect; but we are still unprepared to interpret them. Modeling predicts that intense UV nebular emission can only be produced below a tenth solar metallicity. However, recent HST/COS observations of local galaxies suggest that extreme populations of Wolf-Rayet (WR) stars, the hot exposed cores of massive O stars, may be capable of powering CIII] at metallicities as high as a half-solar. If these moderately metal-poor extreme WR galaxies are indeed a viable source of strong CIII] emission, our interpretation of CIII] detections in the reionization era will be dramatically altered; but we presently have sufficient UV coverage for only three examples. Here, we propose HST/COS G160M and G185M observations of an additional seven extreme WR galaxies spanning 0.5 dex in metallicity around half-solar. These observations will constrain the maximum CIII] equivalent width these galaxies can power as a function of metallicity. The moderate resolution gratings will robustly characterize the massive O and WR star populations, allowing us to link the nebular emission directly to the massive stars responsible. These data will provide a stringent test for the population synthesis codes which will be applied to JWST observations. Without this empirical baseline, our understanding of the most distant galaxies JWST finds will be severely limited.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15117
Program Title: BUFFALO

Principal Investigator: Charles Steinhardt
PI Institution: University of Copenhagen, Niels Bohr Institute

We propose the Beyond Ultra-deep Frontier Fields and Legacy Observations (BUFFALO), 96 orbits (plus 5 for supernova followup) around the six HST Frontier Fields to probe the z>8 universe, learn about early galactic assembly and clustering, and prepare targets for JWST NIRSpec observations. Specifically, we will place significant new constraints on how and when the most massive and luminous galaxies in the universe formed, and how early galaxy formation is linked to dark matter assembly. The same data will also probe the temperature and cross section of dark matter in the massive Frontier Fields galaxy clusters, and tell us how the dark matter, cluster gas, and dynamics of the clusters influence the galaxies in and around them. These important studies are possible because Spitzer, Chandra, and ground based telescopes have already invested heavily in deep observations around the Frontier Fields, and so a relatively modest additional allotment of HST time (4% of what has already been allocated) yields significant new results. Our team is designed to rapidly exploit these data by: 1) Finding new z>7 sources in the data and following them up with spectroscopy, with particular attention given to the unexpectedly massive sources recently found at z>8; 2) Improving the existing strong lens maps and extending them in both area and accuracy using weak lensing with a combination of HST and ground based data; 3) Providing extensive ground based follow-up of the cluster and lensed galaxies; and 4) Carrying out a range of legacy studies designed to prepare for JWST NIRSpec and produce enduring data products from these data and planned follow-up observations for the community.
Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15087
Program Title: Star Cluster Populations of Interacting Dwarf Galaxies

Principal Investigator: Sabrina Stierwalt

PI Institution: The University of Virginia

We propose high spatial resolution optical, UV, and narrowband Hα imaging of 6 nearby pairs of dwarf galaxies with enhanced star formation likely driven by a dwarf-dwarf interaction. Dwarf-dwarf interactions dominate galaxy interactions at all redshifts, making this environment essential to our understanding of galaxy assembly and star formation throughout the universe. However, little is known about how galaxy mergers proceed at low mass. The high resolution observations proposed here will resolve individual star clusters (a goal not currently possible from the ground) to explore the role of tidal interactions in triggering clumpy star formation and in promoting the formation of massive star clusters in low metallicity environments. This mode of cluster formation was likely dominant during early galaxy assembly, and the extent to which star formation is clumped is predicted to play a role in the extent to which feedback impacts the interstellar medium. Our sample of isolated dwarf-dwarf interactions offers the only opportunity for a high resolution view of this mode of cluster formation outside the influence of a massive galaxy host.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Galaxies and the IGM  
ID: 15290  
Program Title: Spectacular optical filaments in the X-ray brightest group cool core

Principal Investigator: Ming Sun  
PL Institution: University of Alabama in Huntsville

Studies of the cold gas and star formation in X-ray cool cores are important for understanding galaxy formation and evolution. An eye-catching and mysterious phenomenon in X-ray cool cores is the optical emission-line nebula, which is similar to those filaments found around distant radio galaxies and some proto-galaxies. These optical emission-line nebulae are markers of the cold gas and the AGN feedback process. They provide important kinematic and timescale constraints on gas flows in cool cores, from ~ 50 kpc down to regions within the Bondi radius on scales of 50 - 100 pc. We have obtained optical narrow-band imaging data for a sample of cool cores in galaxy groups and some interesting systems were revealed. In this proposal, we ask for the WFC3 narrow-band imaging data of the brightest and the closest Halpha nebula in the sample, as well as the NUV data to study the associated star formation. The proposed HST observations, in combination with our rich supporting data in other bands, will provide important constraints on the properties of optical filaments, the strength of magnetic field and the star formation history in the cool core and energy transfer.
Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15355
Program Title: Perfect Blackbody Spectra for JWST and Next Generation UV-Opt-IR Standard Star Network

Principal Investigator: Nao Suzuki
PI Institution: Institute for Physics and Mathematics of the Universe

We propose to observe 18-19th magnitude objects with nearly perfect blackbody spectra discovered by the Sloan Digital Sky Survey. Follow-up observation by Keck/LRIS and Subaru/FOCAS confirmed no signs of absorption lines, and SDSS multi-epoch observation shows no time variation. With WFC3 (UVES/IR), we will establish a new network of Opt-IR Standards at 0.1% precision in magnitude from 0.1 micron through 5 micron. The identify of these objects are yet to be known. We conduct precise parallax measurements and find distances to these objects that enables us to infer the radius of these stars, and we may have a potential discovery of new type of objects.

Only two parameters (Effective Temperature and Normalization) are needed to describe the blackbody spectra, and we can predict magnitudes in any band from UV through IR with high precision. We will advance the way we perform the photometry by introducing the covariance matrix between the filter bands. This covariance matrix would reduce the errors in color and propagate systematic errors in an appropriate way, and we can reduce the systematic errors in SNIa cosmology today. The perfect blackbody spectrum is the most elegant solution for JWST photometric standards and next generation UV-Opt-IR photometry.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Cosmology
ID: 15291
Program Title: Identifying gamma-ray bursts at very high redshifts

Principal Investigator: Nial Tanvir
PI Institution: University of Leicester

Gamma-ray bursts are bright enough to be seen to very great distances and their afterglows can provide redshifts and positions for their host galaxies, and in some cases details of the ISM and the IGM close to the burst, irrespective of the host magnitude itself. Thus GRBs, despite their small numbers, offer a unique and powerful tracer of early star formation and the galaxy populations in the era of reionization. Our efforts to identify high-z GRBs have been rewarded with the discoveries of GRB 090423 and GRB 120923A at spectroscopic redshifts of 8.2 and 7.8 respectively. However, it remains the case that some good candidate high-z GRBs cannot be followed up quickly or deeply enough with ground-based IR spectroscopy, and indeed for others the Ly-alpha break may fall in regions of the IR spectrum difficult to access from the ground. GRB 090429B is an example, which had a photo-z of 9.4, but for which spectroscopy was curtailed due to bad weather. WFC3/IR on HST can obtain redshifts based on the location of the Ly-alpha break via slitless grism spectroscopy to considerably deeper limits (and hence later times) than is possible from the ground, thus offering a solution to this problem. This proposal aims to continue to build the sample of z>7 GRBs by obtaining spectroscopy for up to two candidates for which photometry suggests a very high redshift, but where the redshift could not be secured from the ground. This will provide an important legacy of host galaxy targets with known redshifts for future studies with JWST. The low rate of z>7 GRBs leads us to request a long-term ToO program, spanning cycles 25 and 26.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15292
Program Title: r-process kilonovae, short-duration GRBs, and EM counterparts to gravitational wave sources

Principal Investigator: Nial Tanvir
PI Institution: University of Leicester

Our HST observations of the short-duration gamma-ray burst GRB130603B showed an infrared excess, about a week (rest-frame) after the burst, consistent with expectations from models of an emerging 'kilonova' (aka. 'macronova') driven by the radioactive decay of newly-synthesised r-process elements. This directly supports the compact object merger hypothesis for short-GRBs, in which the merger produces ultrarelativistic jets and ejected neutron star material powers a radioactive transient, with high opacity shifting the emission into the IR. If confirmed in future events, this discovery also provides evidence for a quasi-isotropic, electromagnetic signature of a prime target for gravitational wave (GW) detection by aLIGO/AdV, and suggests that kilonovae of this sort are likely sites of substantial (perhaps dominant) production of r-process elements in the universe. However, the ubiquity and diversity of these events is hardly constrained; their luminosity is expected to depend on the ejecta mass and velocity, and may be enhanced by ongoing energy input from the compact remnant. Theoretical models predict a wide range of behaviour, dependent on binary parameters, but are limited by uncertainties in the complex physics. We need to establish kilonova properties empirically, to inform searches of GW error boxes, test the models, and quantify their contribution to the heavy element nucleosynthesis budget. Suitable SGRB targets are rare, so intensive followup of any that occur is critical. We propose ToO observations (continuing our c23/24 campaign) of up to two z<=0.35 SGRBs localised during cycle 25/26 to search for and characterise more fully any accompanying kilonova signal.
Proposal Category: GO
Scientific Category: Planets and Planet Formation
ID: 15149
Program Title: Validating the Presence of a Moon Orbiting Kepler-1625b

Principal Investigator: Alex Teachey

PI Institution: Columbia University in the City of New York

The Hunt for Exomoons with Kepler (HEK) project has been engaged in the search for exomoons for the past several years, but so far no reliable exomoon detection can be found in the literature. After our largest survey to date, we have recently detected a strong candidate moon signal in the light curve of Kepler-1625b. The planet exhibits three transits in the Kepler data (P~287 days), in which we detect out-of-transit flux dips consistent with the presence of a large moon to greater than 4 sigma confidence. We propose to observe the next transit of the planet, which will occur October 29th, 2017 (Cycle-25), in the near-infrared using the Wide Field Camera 3 instrument on HST. We request 26 orbits of the telescope, which will allow us to capture the full planet-moon transit event and provide an opportunity to measure the transmission spectra of both the planet and the moon. We anticipate that the proposed measurements would be sufficient to confirm the first unambiguous detection of a moon beyond our Solar System.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15293
Program Title: Pinpointing the cosmic web between massive galaxy clusters

Principal Investigator: Nicolas Tejos
PI Institution: Millennium Institute of Astrophysics

We propose to observe and characterize the intergalactic medium (IGM) in the densest filaments of the cosmic web at 0.1<z<0.5. We use massive galaxy cluster-pairs (M_cl > 1.3 x 10^14 M_sun) to identify zones where inter-cluster filaments should reside with high probabilities, and cross-match them with bright UV QSOs for feasible FUV spectroscopy. Here we propose to observe the 9 best QSOs with HST/COS, in order to probe the HI and OVI transitions at the redshifts of 9 independent massive cluster-pairs within <3 Mpc from the inter-cluster axes. We require S/N>12 using the G130M (and G160M for those at z>0.16) to ensure a full characterization of low column density gas (N~10^13.0-13.5 cm^-2) in these intervening structures. This proposal builds upon our previous pilot programs from single targeted QSO sightlines intersecting multiple cluster-pairs (IDs 12958 and 13832, PI Tejos), which have led to promising results (Tejos et al. 2016). In particular, the present experiment will enable the detection of broad and shallow HI lines with OVI (if any), believed to be associated with portions of the warm-hot intergalactic medium (WHIM), as well as test alternative hypothesis regarding the origin of OVI lines. This proposal will double the current sample available in the HST archive, for a total of ~20 high-quality cluster-pairs probed. According to our estimations, this sample will provide a robust statistical detection of the elusive WHIM signatures, at the 99% confidence level. Even more fundamentally, these data will provide a unique test of structure and galaxy formation by comparing them with state-of-the-art hydrodynamical simulations.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Galaxies and the IGM
ID: 15186
Program Title: Enabling HST UV Exploration of the Low Surface Brightness Universe: A Pilot Study with the WFC3 X Filter Set

Principal Investigator: David Thilker
PI Institution: The Johns Hopkins University

We request 17 orbits to conduct a pilot study to examine the effectiveness of the WFC3/UVIS F300X filter for studying fundamental problems in star formation in the low density regime. In principle, the broader bandpass and higher throughput of F300X can halve the required observing time relative to F275W, the filter of choice for studying young stellar populations in nearby galaxies. Together with F475W and F600LP, this X filter set may be as effective as standard UVIS broadband filters for characterizing the physical properties of such populations. We will observe 5 low surface brightness targets with a range of properties to test potential issues with F300X: the red tail to 4000A and a red leak beyond, ghosts, and the wider bandpass. Masses and ages of massive stars, young star clusters, and clumps derived from photometry from the X filter set will be compared with corresponding measurements from standard filters. Beyond testing, our program will provide the first sample spanning a range of LSB galaxy properties for which HST UV imaging will be obtained, and a glimpse into the ensemble properties of the quanta of star formation in these strange environments. The increased observing efficiency would make more tractable programs which require several tens to hundreds of orbits to aggregate sufficient numbers of massive stars, young star clusters, and clumps to build statistical samples. We are hopeful that our pilot observations will broadly enable high-resolution UV imaging exploration of the low density frontier of star formation while HST is still in good health.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Solar System
ID: 15259
Program Title: UV Spectroscopy of Lucy Mission Targets

Principal Investigator: Cristina Thomas
PI Institution: Planetary Science Institute

The Trojan asteroids are a significant population of primitive bodies trapped in Jupiter's stable L4 and L5 Lagrange regions. Their physical properties and existence in these particular orbits constrain the chemical and dynamical processes in our early Solar System. NASA's recently selected Lucy mission will perform the first reconnaissance of these asteroids and will answer many fundamental questions about the population. The compositions of the Trojans are not well understood. Spectroscopy and spectrophotometry in visible and near-infrared wavelengths show red slopes (spectra with reflectivity increasing towards the long wavelength end of the spectrum) and no diagnostic spectral absorption features. However, past spectral and photometric observations suggest there are unobserved features in ultraviolet wavelengths.

We propose to obtain ultraviolet spectroscopy with WFC3 of four Trojan asteroids that are targets of the Lucy mission. Lucy will not have the capability to obtain ultraviolet spectra. The proposed observations can only be made using Hubble. We will determine if there are UV spectral features, as suggested by visible wavelength observations, and connect these features to candidate compositional components. These observations will enable connections between the compositions of Trojans and dynamical models of the early Solar System.
Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15187
Program Title: Confirmation of the Most Distant Quasar

Principal Investigator: Vithal Tilvi

PI Institution: Arizona State University

We propose for 8-orbit G141 grism observations to confirm the AGN nature of a z=7.51 galaxy, currently the most distant quasar candidate identified via NV line detection using deep G102 grism observations. The AGN evidence is further supported by a weak line detection in the ground-based MOSFIRE spectrum. Here we request grism observations to better understand the physical processes occurring in this unique galaxy, and confirm its AGN nature via additional lines: CIV, HeII and CIII. Detection of CIV alone will unambiguously confirm its AGN nature. Currently, WFC3 grism is the most efficient instrument for observing these lines as our recent work shows that the flux loss from ground-based slit-spectrographs is significant (>4x) compared with the grism measurements. Furthermore, the CIII line falls on to a bright atmospheric line making it nearly impossible to observe from the ground. Confirmation of the AGN nature of our target will be a tremendous achievement because this discovery implies that the black hole accretion was already in place within the first few million years after the big bang. This also means that at least some fraction of Lyman-break selected galaxies host AGNs, which can enhance the escape of ionizing radiation and thus contribute to the reionization of the intergalactic medium (IGM). Currently there are no observations of faint quasars, M (UV)>-23.2 mag, at z>7. Our proposed observations will push the discoveries to fainter limits, which consequently will start building an excellent base-sample for James Webb Space Telescope for studying the physical nature of sources responsible for reionizing the universe.
Proposal Category: GO
Scientific Category: Massive Black Holes And Their Host Galaxies
ID: 15118
Program Title: TESTING THE RELEVANCE OF MERGERS AND ENVIRONMENT FOR THE FASTEST GROWING BLACK HOLES IN THE MOST INTENSELY STAR FORMING GALAXIES
Principal Investigator: Benny Trakhtenbrot
PI Institution: Eidgenossische Technische Hochschule (ETH)

We propose a pilot study to explore the role of major galaxy mergers in shaping the early history of the largest super-massive black holes (SMBHs).

We will use HST's high sensitivity and resolution to map the stellar content of the host galaxies and close environments of six very luminous QSOs at z~4.8, for which we have obtained a rich collection of ground- and space-based data, including new ALMA data that probe the hosts' gas. Our previous analysis of these systems clearly shows fast SMBH and host galaxy growth, with some systems exhibiting extremely high star formation rates, SFR >2000 M_sol/yr, suggestive of merger-driven activity. Our new ALMA data show evidence for mergers among some of the lower-SFR objects, while presenting no clear evidence for mergers among some of the extreme SFR sources. The deep HST/WFC3-IR imaging data will allow us to look for two types of merger indicators: (1) disturbed star-forming sub-structures within the host galaxies of the QSOs, and (2) close, possibly interacting companions. Thus, the proposed HST observations will provide the only missing ingredient in our long-term effort to identify the dominant mechanism driving the early epoch of SMBH-host (co-)evolution. If successful, the combined HST and ALMA effort will be extended to a larger sample, based on our on-going ALMA cycle-4 observations of 12 additional systems.
Hubble's WFC3 has been a game changer for the study of early galaxy formation in the first 700 Myr after the Big Bang. Reliable samples of sources to redshift z~11, which can be discovered only from space, are now constraining the evolution of the galaxy luminosity function into the epoch of reionization. Unexpectedly but excitingly, the recent spectroscopic confirmations of L>L* galaxies at z>8.5 demonstrate that objects brighter than our own Galaxy are already present 500 Myr after the Big Bang, creating a challenge to current theoretical/numerical models that struggle to explain how galaxies can grow so luminous so quickly. Yet, the existing HST observations do not cover sufficient area, nor sample a large enough diversity of environments to provide an unbiased sample of sources, especially at z~9-11 where only a handful of bright candidates are known. To double this currently insufficient sample size, to constrain effectively the bright-end of the galaxy luminosity function at z~9-10, and to provide targets for follow-up imaging and spectroscopy with JWST, we propose a large-area pure-parallel survey that will discover the Brightest of Reionizing Galaxies (BoRG[4JWST]). We will observe ~580 arcmin^2 over 125 sightlines in five WFC3 bands (0.35 to 1.7 micron) using high-quality pure-parallel opportunities available in the cycle (3 orbits or longer). These public observations will identify more than 80 intrinsically bright galaxies at z~8-11, investigate the connection between halo mass, star formation and feedback in progenitors of groups and clusters, and build HST lasting legacy of large-area, near-IR imaging.
Proposal Category: GO
Scientific Category: Cosmology
ID: 15320
Program Title: Probing the dark universe with quadruply imaged quasars

Principal Investigator: Tommaso Treu

PI Institution: University of California - Los Angeles

Is LCDM the correct model or is the recent tension of H0 suggestive of new physics? What's the nature of dark energy? What's the stellar initial mass function of massive galaxies? What's the structure of dark matter halos? What is the size of accretion disks? How does the relationship between quasars and their host galaxies evolve with redshift? All these questions can be addressed by studying quadruply imaged quasars (quads). Unfortunately, these objects are very rare on the sky and the precision of all these studies is limited by sample size, typically 10-15 for each case. We have embarked in a major campaign to discover and follow-up many new quads. We propose here to observe 13 new systems. This proposal will effectively more than double current samples for each application and thus enable substantial progress on all fronts (e.g. ~1.4% precision on H0 from time delays and differentiating Chabrier and Salpeter initial mass function at 95%CL from microlensing).
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Solar System
ID: 15213

Program Title: A Pure Parallel survey of the colors of small trans-Neptunian objects to constrain the collisional history of the Outer Solar System

Principal Investigator: David Trilling
PL Institution: Northern Arizona University

We propose to use 150 Pure Parallel ACS/WFC orbits within 5 degrees of the ecliptic to search for faint (R>25) trans-Neptunian objects (TNOs). Based on our prior experience we expect to discover 50 faint TNOs, 24 of which will be members of the dynamically isolated cold classical subpopulation. We predict, based on theory and preliminary observational evidence, that cold classical TNOs that are smaller than an observed break in the size distribution should be significantly bluer than large cold classical TNOs due to ongoing collisional evolution of those small bodies. We will obtain V-I colors for all detected TNOs, allowing a statistically significant test of the hypothesized color difference for small cold classicals. If smaller cold classics exhibit bluer colors than large cold classics then the nature of the break in the size distribution is collisional. On the contrary, if the small cold classics are as red as their larger counterparts then the break instead is most likely primordial and a product of the environment in which these objects formed. We have extensive experience detecting faint TNOs in HST data. This well-posed experiment will offer for the first time direct observational evidence about the broad collisional history of the outer Solar System and is only possible with HST.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15321
Program Title: Direct Constraints on the Temperature and Ionization of Low-Redshift O VI Absorbers from Ultra-High Resolution Spectroscopy of H1821+643

Principal Investigator: Todd Tripp
PI Institution: University of Massachusetts - Amherst

The OVI doublet in low-z QSO absorption systems can provide valuable constraints on the mass and physics of highly ionized gas in galaxy halos and the IGM. However, use of the OVI doublet is still hampered by uncertainty regarding the physical nature of these absorbers. Eight OVI absorption systems have been detected on the sight line to the low-redshift QSO H1821+643 with HST+STIS and FUSE. Careful inspection of these absorbers (observed with the STIS E140M echelle) reveals narrow peaks and inflections in the OVI profiles that are closely aligned with well-detected narrow HI and SIII components at the same redshifts. This tentatively suggests that the OVI profiles contain narrow components at cool temperatures. However, the E140M spectral resolution is not adequate to constrain the line widths of these blended components accurately enough to support firm conclusions. We propose to use the E140H echelle mode of STIS to observe H1821+643 with ultra-high spectral resolution (R = 115,000) to place direct constraints on the temperature of the OVI-bearing gas based on the OVI line widths. We will also measure more precise centroids for the OVI, SIII, and HI absorption components and more accurately decompose the multicomponent blends in many of the absorbers. In addition to probing the physics of extragalactic OVI systems, the spectra will provide a wealth of information about the Milky Way ISM and the low-redshift Lya forest.
Proposal Category: GO  
Scientific Category: Cosmology  
ID: 15089  
Program Title: Identify the signature of neutron star mergers through rapid Hubble observations of a short gamma-ray burst  
Principal Investigator: Eleonora Troja  
PI Institution: University of Maryland  

The afterglow of some short gamma-ray bursts (GRBs) displays a late-time rebrightening, visible a few days after the GRB. Recent HST observations provided tantalizing evidence that such late-time bump could be explained as the emergence of the underlying kilonova emission. This would represent the incontrovertible signature of a neutron star merger, and the first direct link between short GRBs and their progenitors. If the kilonova interpretation is correct, it would also confirm that neutron star mergers are significant and possibly dominant sources of the heaviest elements (e.g. gold, platinum, uranium) in the Universe. 

Here we ask for rapid HST follow-up observation of a nearby (z<0.4) short duration GRB in order to detect the expected kilonova bump, and to constrain the origin of the observed emission. Multi-color observations are critical to pin down the nature of the observed rebrightening, and to distinguish it from the standard afterglow. The proposed observations can provide the smoking gun evidence connecting short GRBs and neutron star mergers, and will serve as a powerful observational input in the new era of gravitational wave astronomy.
Proposal Category: GO
Scientific Category: Massive Black Holes And Their Host Galaxies
ID: 15260
Program Title: Ultraviolet Echoes of Quasar Accretion Disks

Principal Investigator: Jonathan Trump
PI Institution: University of Connecticut

We propose a novel ultraviolet monitoring campaign with WFC3/UVIS to measure quasar accretion disk structure. The bulk of supermassive black hole growth occurs in luminous quasar phases of rapid accretion, yet the governing physics remains poorly understood. Continuum reverberation mapping (RM) measures the accretion disk size via the time lag between short- and long-wavelength emission: the proposed UV monitoring forms the foundation for simultaneous optical observations (expected to continue for our quasars through 2019). Currently only 4 Seyfert AGNs have UV/optical RM accretion-disk sizes, all low-luminosity and at z<0.02. We propose to monitor 5 new quasars, spanning an order of magnitude higher accretion rate and out to z~1. The 5 quasar targets are drawn from SDSS-RM, a pioneering multi-object spectroscopic RM campaign, and have been monitored with optical photometry and spectroscopy since 2014. The higher luminosity and accurate RM masses of our sample enable the first measurements of accretion-rate effects on accretion-disk size, with UV monitoring directly probing changes in the inner disk suggested by theory and previous indirect observations. Our proposed HST monitoring campaign is unusually efficient, targeting 5 quasars per orbit using the DASH method with UVIS subarray readouts. We use simulations to demonstrate that our 2-day cadence over 32 epochs will accurately measure continuum lags and accretion-disk structure. Ultraviolet monitoring of these 5 quasars will enable critical new measurements of accretion-disk structure during the rapid accretion mode that dominates black hole growth.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category:       GO
Scientific Category:      Cosmology
ID:                      15150
Program Title:           Local Void Reflex: IR TRGB Distances to Obscured Galaxies at the South
                        Supergalactic Pole

Principal Investigator:  R. Tully
PI Institution:          University of Hawaii

Our galaxy lies in a thin sheet that is part of a wall of the Local Void. It is now evident that our `Local Sheet' has a peculiar velocity of several hundred km/s away from the void. Further, it is evident that there is a compression onto the Local Sheet, with galaxies above and below the sheet exhibiting peculiar velocities toward us. This trend was confirmed with HST observations of a lonely galaxy toward the void center. Galaxies in the opposite direction also have peculiar velocities toward us. However, galaxies with good distances in the sector opposed to the void lie at sufficient angles that only moderate fractions of their anomalous radial motions are directed away from the void. There are good nearby candidates to test the hypothesis of compression toward the Local Sheet but they lie in the zone of obscuration, requiring observations in the infrared. Experience has shown that the measurements are possible with the tip of the red giant branch method, now well calibrated. The experiment is important because the measurement in the void anti-apex coupled with an existing sample of distances to significant redshifts will give the absolute amplitude of expansion of the Local Void. The expansion velocity of a void depends on the size and emptiness of the void and on cosmological parameters. The measurement can only realistically be carried out at this boundary of the Local Void and requires a foundation in the motions of galaxies in the anti-void direction.
Proposed Program: Getting the sigma in the M_BH - sigma relation right

The relation between the mass of the central supermassive black hole (M_BH) and the velocity dispersion of its host spheroid (sigma) is fundamental for our understanding of galaxy evolution and its relation to their nuclei. Correspondingly many HST orbits have been invested in determining accurate M_BH masses. Surprisingly little has been done on standardizing the other axis, i.e. sigma measurements. These values are often derived from various long-slit datasets at different physical radii of the galaxy and no homogeneous definition has been given. We propose to remedy this situation by using our dataset of MUSE and PPAK kinematic maps out to 1 R_e of galaxies with a secure black hole mass. These data are useful for large scale kinematics, however, obtaining velocity dispersions at small radii is not possible. To measure velocity dispersions at small radii we require high-spatial resolution spectroscopy as provided by HST/STIS. In addition, high-resolution photometric data is needed to define consistent apertures in each galaxy. We therefore propose to use the unique capabilities of HST and harvest years of efforts to collect archival spectroscopic and imaging data for BH host galaxies. This will allow creating a catalog of sigma values, calculated in various ways and at various radii and to re-calibrate the M_BH - sigma relation.
Supernovae (SNe) have a profound effect on galaxies and have been used as precise cosmological probes, resulting in the Nobel-distinguished discovery of the accelerating Universe. They are clearly very important events deserving of intense study. Yet, even with over 10,000 classified SNe, we know relatively little about the stars which give rise to these powerful explosions. The main limitation has been the lack of spatial resolution in pre-SN imaging data. However, since 1999 our team has been at the vanguard of directly identifying SN progenitor stars in HST images. From this exciting line of study, the trends from 15 detections for Type II-Plateau SNe appear to be red supergiant progenitors of relatively low mass (8 to 17 Msun) -- although this upper mass limit still requires testing -- and warmer, envelope-stripped supergiant progenitors for 5 Type IIb SNe. Additionally, evidence is accumulating that some Type II-narrow SNe may arise from exploding stars in a luminous blue variable phase. However, the nature of the progenitors of Type IIb/c SNe, a subset of which are associated with gamma-ray bursts, still remains ambiguous. Furthermore, we continue in the embarrassing situation that we still do not yet know which progenitor systems explode as Type Ia SNe, which are being used for precision cosmology. In Cycles 16, 17, and 20 through 24 we have had great success with our approved ToO programs. As of this proposal deadline, we have already triggered on SN 2016jbu with our Cycle 24 program. We therefore propose to continue this project in Cycles 25 and 26, to determine the identities of the progenitors of 8 SNe within about 20 Mpc through ToO observations using WFC3/UVIS.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15152
Program Title: Finally, the Progenitor of the Type Ib iPTF13bvn

Principal Investigator: Schuyler Van Dyk

PI Institution: California Institute of Technology

Supernovae (SNe) are among the most powerful events in the Universe and have a profound influence on galaxy evolution. Whereas we have been able to identify the luminous red supergiant progenitor stars of the most common core-collapse explosions, the hydrogen-rich Type II, the progenitors of hydrogen-poor Type Ib and Type Ic have been far more elusive. To strip away a SN Ib/c progenitor’s outer layers, theoretical models with either (a) a highly-massive star with prodigious winds during the Wolf-Rayet phase or (b) a somewhat lower-mass star in a close, mass-exchange binary system have been proposed. One example exists so far of a progenitor identification, for the SN Ib iPTF13bvn in NGC 5806. Both models have been invoked to explain this event, although most evidence to date points toward the binary model. Our combined team observed this SN with WFC3 in Cycle 22, about 2 years after explosion, to investigate whether the progenitor had disappeared. As a result, we were able to report that indeed it had. We also attempted to better characterize the nature of the progenitor by subtracting our images from the pre-explosion HST data. Unfortunately, the old SN was apparently still conspicuously present. We therefore propose to reimage the SN site, when the SN should then be well below detectability, to produce high-quality templates of the host galaxy for subtraction. We can then finally fully reveal the progenitor and understand its true nature. iPTF13bvn is one of the most important historical SNe and will most probably be the best available case of a SN Ib progenitor for HST’s remaining lifetime. It is imperative to understand the nature of this SN and its progenitor object.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Massive Black Holes And Their Host Galaxies
ID: 15322
Program Title: Coordinated Far-Ultraviolet and Radio Observations of the Feedback Engine in Quasar Mrk 231

Principal Investigator: Sylvain Veilleux
Pl Institution: University of Maryland

The proposed COS far-ultraviolet (FUV) spectroscopic observations target the central engine of Mrk 231, the archetype of quasar feedback in action. Comparisons of our recent FUV COS spectra of this object with noisy 20-year old archival FOS spectra indicates a possible "softening" of the FUV continuum and the disappearance of the C IV broad-absorption line (BAL) wind feature in recent years. Mrk 231 was in a high Blazar-like radio state for all of the recent observations, but in a low radio state during the FOS observations. These tentative results suggest an accretion disk - jet - wind connection, where the C IV BAL wind is suppressed and the inner regions of the FUV continuum-emitting disk are evacuated when the radio jet is turned on. The new HST observation will be triggered in a non-disruptive mode when Mrk 231 is in a low radio state, based on our 14 - 18 GHz radio monitoring program. To facilitate comparisons between low and high radio state observations, the new COS data will be obtained using exactly the same COS setting and exposure time as in our previous observations. These data will allow us to verify if the C IV BAL wind reappears when the jet is turned off and if the FUV spectrum hardens as a consequence of this state change, or if the anecdotal evidence we reported was coincidental and a consequence of events unrelated to the radio jet. Either way, the new observations will shed new light on the long-standing issues of the launching of relativistic jets and fast winds and the impact of jet and wind formation on the accretion flow in general. These same jets and winds are believed to have a crucial impact on galaxy evolution.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Solar System
ID: 15261
Program Title: The Pluto System in the Post-New Horizons Era: Opposition Effects, Rotations, and Orbital Stability

Principal Investigator: Anne Vervoegher
PI Institution: The University of Virginia

Following the New Horizons flyby in 2015, we propose a two-cycle program to observe Pluto and its five moons in the post-encounter era, building on the rich legacy of observations obtained during and prior to the historic flyby. At opposition in Cycles 25-26, the Pluto system is visible at the smallest solar phase angle in 87 years. The system will be at true opposition when it crosses the line of nodes in July 2018, and as seen from Pluto, Earth will transit the solar disk. Such rare planetary alignments enable the characterization of small-scale surface texture and porosity as well as the direct measurement of the geometric albedo, rather than an estimation of its value from photometric models. Any variation among the regolith properties of Pluto’s moons will test the long-standing hypothesis that ejecta exchange between the moons has altered their surfaces. We will also follow up on the surprising result from New Horizons and HST that the small moons are spinning rapidly and with high obliquities. Styx, Nix, and Hydra show hints of being in strong spin-orbit couplings with Charon, but confirmation requires the additional precision in measurements of their spin rates and polar precession rates proposed here. In addition, we will obtain new astrometry of the small moons, making it possible to determine their masses and bulk densities with much higher precision. Results from this program will enhance the scientific return from the New Horizons mission, providing images complementary to those obtained by the spacecraft on approach and achieving science objectives that cannot be met by either HST or New Horizons alone.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Massive Black Holes And Their Host Galaxies
ID: 15323
Program Title: Addressing a Bias in the Galaxies with Black Hole Mass Measurements

Principal Investigator: Jonelle Walsh
PI Institution: Texas A & M University

Supermassive black holes (BHs) are fundamental components of galaxies, as demonstrated by the correlations between BH mass and large-scale galaxy properties. However, these scaling relations are based on BH mass measurements in a galaxy sample that is significantly biased relative to the overall galaxy population. We propose to enhance the diversity of galaxies with BH mass determinations using a combination of Hubble Space Telescope (HST) imaging and adaptive optics (AO) kinematics. Our proposal focuses on 25 galaxies that will be observed as part of an approved 253-hour Gemini Large Program to dynamically measure BH masses. HST imaging is required for (1) the creation of high-resolution stellar mass models, and (2) the determination of the AO point spread function; both are essential for measuring accurate BH masses. The proposed sample will provide a more complete census of local BHs in a wide range of galaxies with varied evolutionary histories. This data is crucial for understanding the underlying physics driving the BH - galaxy correlations and their scatter.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Planets and Planet Formation  
ID: 15119  
Program Title: Probing the young circumplanetary environment of Beta Pic b during transit egress

Principal Investigator: Jason Wang  
PI Institution: University of California - Berkeley

Among the thousands of known exoplanets, Beta Pic b is the only directly imaged exoplanet with a nearly edge-on orbit. We show that the latest astrometric measurements rule out a transit by the planet at 10-sigma significance, but we are certain that the Hill sphere of the planet will transit. With a period of ~22 years and no other system like it, this Hill sphere transit provides a rare opportunity to study the evolving circumplanetary environment of a young and well-characterized exoplanet. To compliment GO-14621, our Cycle 25 proposal to monitor the ingress of the Hill sphere, we propose a modest HST program to photometrically search for signatures of the planet's large scale circumplanetary material during the egress of the Hill sphere transit. The existence of such material is plausible given that Beta Pic's young age is similar to that of the ring-bearing J1407b system. Combined with GO-14621 and less-precise but dedicated ground-based monitoring, these observations will give us a comprehensive set of observations about this young circumplanetary environment. Given the sparse observational data of circumplanetary environments, non-detections will also be valuable for constraining the timescales relevant to circumplanetary material and moon formation. If photometric variations are detected with HST, these results would yield empirical information concerning the dynamics of the system and the evolution of planetary systems as a whole.
Proposal Category: AR
Scientific Category: Stellar Populations
ID: 15055
Program Title: A Unified Picture of Mass Segregation in Globular Clusters

Principal Investigator: Laura Watkins
PI Institution: Space Telescope Science Institute

The sensitivity, stability and longevity of HST have opened up an exciting new parameter space: we now have velocity measurements, in the form of proper motions (PMs), for stars from the tip of the red giant branch to a few magnitudes below the main-sequence turn off for a large sample of globular clusters (GCs). For the very first time, we have the opportunity to measure both kinematic and spatial dependences on stellar mass in GCs.

The formation and evolution histories of GCs are poorly understood, so too are their intermediate-mass black hole populations and binary fractions. However, the current structure and dynamical state of a GC is directly determined by its past history and its components, so by understanding the former we can gain insight into the latter. Quantifying variations in spatial structure for stars of different mass is extremely difficult with photometry alone as datasets are inhomogenous and incomplete. We require kinematic data for stars that span a range of stellar masses, combined with proper dynamical modelling. We now have the data in hand, but still lack the models needed to maximise the scientific potential of our HST datasets.

Here, we propose to extend existing single-mass discrete dynamical-modelling tools to include kinematic and spatial variations with stellar mass, and verify the upgrades using mock data generated from N-body models. We will then apply the models to HST PM data and directly quantify energy equipartition and mass segregation in the GCs. The theoretical phase of the project is vital for the success of the subsequent data analysis, and will serve as a benchmark for future observational campaigns with HST, JWST and beyond.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15153
Program Title: The jets and shocks of NGC 1333: a large WFC3 mosaic of [Fe II] and H I line emission

Principal Investigator: Dan Watson
PI Institution: University of Rochester

We propose to use Hubble and WFC3 to acquire mosaics of narrowband images of NGC 1333 and its associated molecular cloud, in three spectral lines: [Fe II] 1.26 and 1.64 microns, and H I PaB 1.28 microns. The mosaic will yield extinction-corrected, exquisitely resolved images of at least 18 outflows in their entirety: embedded, bipolar jets, and chains of Herbig-Haro objects. Here is what we hope to learn thereby:

1. With the high angular resolution of HST, we will detect the atomic component of each jet; delineate the fine details of all internal jet shocks and terminal Mach disks; and definitively characterize regions suspected to be jet-jet collisions.

2. Combined with our Spitzer Infrared Spectrograph images of NGC 1333 in many mid-infrared atomic fine-structure and molecular lines, our HST data will enable comprehensive characterization of all of the atomic shocks in these outflows: preshock density, shock speed and peak postshock temperature, outflow source mass loss rate, and the degree to which iron is added to the gas due to dust destruction in the shocks.

3. As the total extinction through the molecular cloud has previously been measured, the extinctions which we measure will allow a novel, quasi-three-dimensional determination of the jet locations within the cloud, allowing an estimate of the degree to which outflow deposit energy and momentum, and entrain material, in the cores and surfaces of the molecular cloud separately.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category:        AR
Scientific Category:      Stellar Populations
ID:                     15056
Program Title:           Measuring the High-Mass IMF in Low-Metallicity Dwarf Galaxies

Principal Investigator:  Daniel Weisz
PI Institution:          University of California - Berkeley

We propose to measure the stellar initial mass function above >1-2 Msun in 46 nearby dwarf galaxies with archival HST observations. This novel approach leverages the redundant age information provided by the main sequence and blue core helium burning stars <500 years old to break the well-known degeneracy between the IMF and star formation history (SFH), enabling a direct measurement of the high-mass IMF in dwarf galaxies. We will be able to constrain the high-mass IMF slope to a precision better than 0.1 to 0.3 dex in each galaxy. Our sample spans a factor of 6 in metallicity (≈5-30% Zsun), ∼4 decades in star formation rate, and ∼3 decades in both stellar and gas mass, allowing us to explore the IMF over a wide range of extreme environments.

Current observational evidence suggests that nearby dwarf galaxies are the most likely candidates to host significant and systematic variations in the high-mass IMF (e.g., Halpha/UV ratios). However, to date there have been no direct measurements of the high-mass IMF in environments with lower star formation rates and/or more metal poor than the Magellanic Clouds. Our program remedies this shortcoming allowing us to (1) make the first-ever measurement of the high-mass IMF in extremely metal-poor environments; (2) empirically quantify environmental the (lack of) variations in the high-mass IMF; (3) directly test the integrated galactic mass initial mass function (IGIMF), which predicts environmental sensitivity of the IMF in dwarf galaxies.
Galactic-scale winds are a common feature of galaxy formation models, and are observed ubiquitously across the star-forming sequence down to ~0.5 Msun/yr. However, empirical constraints on the radial density profile and total spatial extent of these winds have been very challenging to obtain. At the same time, direct empirical evidence is scarce for the flows of gas onto galaxy disks that are critical for maintaining star formation. We have devised a simple experiment using blue horizontal branch (BHB) stars in the halo of the Milky Way that will directly map the location and density of diffuse, ionized gas flows between the Galactic disk and halo. This experiment, initiated in Cycle 23, obtains COS FUV spectra of halo BHB stars that sample a range of scale heights to 13 kpc towards the Northern Galactic pole. In this Cycle, we propose to observe 3 additional BHB stars along the complementary sightline to the South, effectively doubling our sightline sample size and permitting a novel test of the symmetry of gas flows at the disk-halo interface. This program allows us to unambiguously track inflowing and outflowing material from the Milky Way via absorption component blueshifts and redshifts. With BHBs at a range of known distances, we will directly determine changes in the gas density and metal mass as it travels through the disk-halo interface. Our experiment will yield the most detailed constraints on the physical state and energetics of the gas in the Milky Way's Galactic Fountain to date. Such constraints are fundamental to understanding the role of feedback in building the Galactic gaseous halo and the extent to which ongoing gas accretion fuels the ISM.
Proposal Category: AR
Scientific Category: Galaxies and the IGM
ID: 15057
Program Title: Understanding the physics of gas stripping and star-formation quenching of the satellite dwarf galaxies in the Local Group

Principal Investigator: Andrew Wetzel

PI Institution: University of California - Davis

The Milky Way (MW) and M31 are among the best systems to study the physics of the halo environment on galaxy evolution. Nearly all of the satellite dwarf galaxies of the MW and M31 are gas-poor and have quenched star formation. Over 1200 orbits of HST observations of these satellites now provide detailed star-formation histories and proper-motion velocities for full 6-D orbital phase-space, informing both when and where each satellite quenched. However, the lack of sufficiently realistic theoretical models of gas stripping represents a severe limitation to leveraging the astrophysical returns of these HST observations.

We propose to use the new Latte cosmological zoom-in hydrodynamic simulations of MW- and M31-mass systems to understand the environmental processes that strip gas from satellite dwarf galaxies and quench their star formation. Our initial Latte simulations form realistic satellite populations, with star-formation histories that agree well HST measurements. These simulations use the state-of-the-art FIRE model for star formation and feedback: this feedback drives strong gas outflows within dwarf galaxies that can enhance the efficiency of ram-pressure stripping within the halo. We will run a new suite of simulations carefully targeted to the Local Group, and we will investigate how the combination of internal feedback and external stripping leads to rapid quenching, as observed by HST. Finally, we will publicly release our satellite galaxy/subhalo catalogs, including their full orbital and star-formation histories, to compare with existing/upcoming HST observations, providing detailed insight into the physics of environmental quenching.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Massive Black Holes And Their Host Galaxies
ID: 15188
Program Title: ToO observations of fast-evolving tidal disruption events

Principal Investigator: Thomas Wevers
PI Institution: Radboud Universiteit Nijmegen

Stars that pass too close to a supermassive black hole (SMBH) will be ripped apart due to the tidal forces of the hole. A luminous electro-magnetic flare at wavelengths ranging from the X-ray, UV, optical, IR and radio ensues when half of the disrupted star falls back, quickly circularizes to form an accretion disk and is eventually accreted. The rate at which such tidal disruption events (TDEs) occur depends strongly on the occupation fraction of $10^{4-5}$ solar masses black holes, as it is expected to be dominated by low mass SMBHs. As such, TDEs will allow us to probe the low mass end of the SMBH mass function, and potentially down to the intermediate mass black hole (IMBH) mass range $\sim 10^5$ solar masses. The photometric evolution timescale of a TDE depends on its host black hole mass: TDEs around lower mass black holes evolve faster. A preferred avenue to probe the low mass end of the BH mass distribution is therefore to study fast-evolving TDEs. The discovery of two recent, fast-evolving transients in the nuclei of low mass host galaxies may represent the first objects of the class of TDEs around IMBHs. With this non-disruptive ToO proposal, we propose to 1 epoch of high spatial resolution imaging of at most 2 fast-evolving nuclear transients to establish their TDE+IMBH nature as follows: i) verify the nuclear nature of the transient, and ii) obtain a black hole mass estimate by using the mass - luminosity (M-L) relation. These observations may thus lead to the detection of IMBHs!
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Cosmology
ID: 15324
Program Title: Imaging the Lenses in the Quintuple Gravitational Lens PMN J0134-0931

Principal Investigator: Tommy Wiklind
PI Institution: Catholic University of America

The gravitational lens PMN J0134-0931 is one of only two known non-cluster lenses producing six images of the background source. In this case the source is a quasar located at z=2.2 and the lens plane at z=0.76. It is likely that a small compact group of galaxies are located in the lens plane. The lens modeling for these six-image systems has, however, proven to be extraordinarily complicated and no satisfactory lens model has been produced for this system.

PMN J0194-0931 is also unique in the sense that it is one of only two cases where molecular absorption lines are seen against two or more background images, the other one being PKS1830-211. The absorption lines make it possible to probe the kinematics of the lensing galaxies on sub-kpc scales and to determine kinematically derived total masses. Comparing with the mass derived from lens models, it provides a test of the assumed dark matter halo profile. In order to use the absorption lines to constrain the rotation curve it is necessary to know where the sight lines cross the galaxies, the galaxy center and their inclination.

The goal with this proposal is to image the galaxies at z=0.76 that lens the background quasar PMN J0134-0931. At optical and near-infrared wavelengths the highly magnified background quasar dominates the light. Attempts to subtract the quasar light has not produced useable results. We propose to observe PMN J0134-0931 at a wavelength short of the redshifted Lyman limit of the background quasar. This ensures that the quasar is essentially "turned off". This can be accomplished by using the WFC3/F275W filter. The lensing galaxies will be observed in restframe 1500A.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15120
Program Title: Measuring the Deceleration of a Supernova Remnant Shock Wave using High-Precision Astrometry

Principal Investigator: Brian Williams
PI Institution: Space Telescope Science Institute

We propose a third epoch of HST imaging of the NW filament of the remnant of SN 1006. Proper motions have been measured for this remnant in multiple wavelengths, and are nearly 0.3" per year in the NW filament, the only part of the remnant that is bright at optical wavelengths. A first epoch observation with HST was done in 2006, with a second epoch completed in 2013. We propose for a third epoch, with which we will measure, for the first time, the change in the velocity of the shock wave of a supernova remnant. Doing this will require high-precision astrometry, as we will need to measure the proper motions to an accuracy of a few tenths of a milliarcsecond per year. This is achievable with HST, and members of our group have made measurements even more accurate than this in recent years on other astronomical sources. A direct deceleration measurement would avoid the sources of uncertainty that are encountered by indirect inferences. This measurement would add an additional constraint to hydrodynamic simulations of the evolution of SN 1006, as well as serve as a diagnostic on the density of the interstellar medium that the shock wave is sweeping up. Only Hubble has the capabilities of performing a measurement like this, and a measurement of the deceleration of this shock wave would open a new window into SNR evolution for SN 1006 and other remnants with fast shock waves.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Planets and Planet Formation  
ID: 15189  
Program Title: Post Common Envelope Binaries as probes of M dwarf stellar wind and habitable zone radiation environments

Principal Investigator: David Wilson  
PI Institution: The University of Warwick

M dwarf stars are promising targets in the search for extrasolar habitable planets, as their small size and close-in habitable zones make the detection of Earth-analog planets easier than at Solar-type stars. However, the effects of the high stellar activity of M dwarf hosts has uncertain effects on such planets, and may render them uninhabitable. Studying stellar activity at M dwarfs is hindered by a lack of measurements of high-energy radiation, flare activity and, in particular, stellar wind rates. We propose to rectify this by observing a sample of Post Common Envelope Binaries (PCEBs) with HST and XMM-Newton. PCEBs consist of an M dwarf with a white dwarf companion, which experiences the same stellar wind and radiation environment as a close-in planet. The stellar wind of the M dwarf accretes onto the otherwise pure hydrogen atmosphere white dwarf, producing metal lines detectable with ultraviolet spectroscopy. The metal lines can be used to measure accretion rates onto the white dwarf, from which we can accurately infer the stellar wind mass loss rate of the M dwarf, along with abundances of key elements. Simultaneous observations with XMM-Newton will probe X-ray flare occurrence rate and strength, in addition to coronal temperatures. Performing these measurements over twelve PCEBs will provide a sample of M dwarf stellar wind strengths, flare occurrence and X-ray/UV activity that will finally shed light on the true habitability of planets around small stars.
Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15294
Program Title: The GOGREEN Survey: The Relationship between Quenching, Morphological Transformation and Size Growth of Satellite Galaxies

Principal Investigator: Gillian Wilson
PI Institution: University of California - Riverside

Despite a dramatic build-up in the number of quenched galaxies at z < 2, it is still entirely unclear how this quenching comes about. Potential quenching mechanisms fall into two categories: processes that act on "centrals" and those that act on "satellites". While both hydrodynamic and semi-analytic models do a good job of predicting the quenched fraction of centrals, they overpredict the fraction of quenched satellite galaxies, reflecting our much greater uncertainty about how "environmental" quenching occurs. Our 55-night Gemini Observatory "Large and Long Program" GOGREEN survey is obtaining optical spectroscopy for an unprecedentedly large sample of > 1000 members of 12 Coma- and Virgo-mass progenitor clusters at 1 < z < 1.5 (and > 600 field galaxies). Here, we propose for WFC3/F160W imaging of the GOGREEN sample to 1) measure the relative timing of star-formation quenching and morphological transformation, 2) make the first high-z measurement of satellite quenching by controlling for intrinsic quenching, and 3) constrain the dominant driver of size growth in the early-type population. Our team has the modeling framework to interpret the trends and to place unrivaled constraints on the physical processes that underlie environmental quenching and morphological transformation from late- to early-type galaxies. Because of Gemini Observatory's huge investment in the GOGREEN program, this survey will return the premier high-redshift cluster spectroscopic dataset for the foreseeable future. All reduced images, spectra and catalogs will be made publicly available, including catalogs from the F160W observations proposed here.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: AR  
Scientific Category: Galaxies and the IGM  
ID: 15058  
Program Title: What drives the evolution of Luminous Compact Blue Galaxies in Clusters vs. the Field?  
Principal Investigator: Gregory Wirth  
PI Institution: Battelle

Present-day galaxy clusters consist chiefly of low-mass dwarf elliptical galaxies, but the progenitors of this dominant population remain unclear. A prime candidate is the class of objects known as Luminous Compact Blue Galaxies, common in intermediate-redshift clusters but virtually extinct today. Recent cosmological simulations suggest that the present-day dwarfs galaxies begin as irregular field galaxies, undergo an environmentally-driven starburst phase as they enter the cluster, and stop forming stars earlier than their counterparts in the field. This model predicts that cluster dwarfs should have lower stellar mass per unit dynamical mass than their counterparts in the field. We propose a two-pronged archival research program to test this key prediction using the combination of precision photometry from space and high-quality spectroscopy. First, we will combine optical HST/ACS imaging of five $z=0.55$ clusters (including two HST Frontier Fields) with Spitzer IR imaging and publicly-released Keck/DEIMOS spectroscopy to measure stellar-to-dynamical-mass ratios for a large sample of cluster LCBGs. Second, we will exploit a new catalog of LCBGs in the COSMOS field to gather corresponding data for a significant sample of field LCBGs. By comparing mass ratios from these datasets, we will test theoretical predictions and determine the primary physical driver of cluster dwarf-galaxy evolution.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Planets and Planet Formation
ID: 15219
Program Title: Super-Keplerian Motions in the AU Mic Circumstellar Debris System

Principal Investigator: John Wisniewski
PL Institution: University of Oklahoma Norman Campus

We found enigmatic, few-au-scale features in spatially resolved near-IR scattered light observations of the AU Mic debris disk system obtained with VLT/SPHERE in 2014. We recovered these structures in re-analysis of HST/STIS imagery from 2010/2011, and discovered that they are moving away from the star at super-Keplerian speeds, possibly escaping the system. To-date, these are the only moving features seen in resolved imagery of debris disks. To help diagnose the origin of this phenomenon and in concert with multi-wavelength diagnostics being pursued with other facilities, we propose to use 12 orbits of HST/STIS to re-image the AU Mic scattered light disk from 0.2'' (2 au) to 13'' (130 au) ~8 years after the previous epoch of HST/STIS imagery. HST/STIS provides the only means to trace the motion of structures that have already moved outside the FOV of ground-based extreme-AO imagers, the best means to accurately diagnose the morphological and kinematic evolution of these moving features, and the best means to trace the evolution of small grains in the system. Our optical STIS coronagraphy observations are critically needed to establish the locations and shapes of the blobs, establish their optical fluxes at high photometric fidelity, and therefore enable (IR - optical) colors of disk features to be measured in JWST's cycle-1, using NIRCAM's and MIRI's coronagraphs. These data will constrain the grain size distribution, hence mass, of the moving features and by extension the magnitude of the force that is expelling the features, enabling us to test whether mechanisms like the stellar wind or coronal-mass ejections are responsible for the newly observed phenomenon.
Improving our understanding of star formation at low metallicity is of large relevance for a variety of fields in astrophysics since it relates to multiple topical questions. These range from understanding the properties of galaxies that contributed to cosmic reionization to the evolution of metal poor massive stars that give rise to the formation of heavy binary black holes. Crucial are observational constraints for the theoretical predictions, which can be obtained from rest-frame UV spectra of local star-forming dwarf galaxies with ionized-gas oxygen abundances at the low-metallicity threshold of the nearby Universe.

While samples of UV spectra exist for galaxies in the metallicity range above 1/20 solar, only two useful spectra covering from H I Lyman-alpha (LyA, 1216 Ang) to C III] 1909 are available at lower metallicites. We propose COS G140L observations of eight extremely-metal poor galaxies (XMPGs) with He II emission that will: i) provide three more spectra with 12+log(O/H)=<7.4 (suitable targets at such low Z are hard to find), and ii) leverage existing Chandra images which are useful for discrimintating among different sources of ionization.

Combining this dataset with existing spectra at similar and higher metallicity will allow us to address three questions: 1) How does metallicity determine galaxy properties?, 2) Is narrow He II emission a good tracer of peculiar massive stars?, and 3) Can we probe star-formation at high redshift with UV lines other than LyA? Our study will provide valuable clues for interpreting rest-frame UV spectra of high-z galaxies that will challenge our understanding of star formation at low Z.
Recent theories of solar system evolution describe a period of chaotic dynamical restructuring that greatly altered the orbital architecture of the giant planets. A key prediction of these models is that the Jupiter Trojans originated in the outer Solar System and were scattered inward during this period of dynamical instability and captured into resonance. Therefore, understanding the composition of Trojans serves as a crucial observational test of these models. While optical spectroscopy has so far not revealed any spectral features, the bimodality in visible color indicates that Trojans are comprised of two subpopulations. In the context of dynamical instability models, both of these groups must originate in the outer Solar System. We have hypothesized that the color bimodality is due to differential sublimation loss of volatile ices and irradiation, with retention or depletion of hydrogen sulfide ice being the determining factor in the surface color. Laboratory spectra of irradiated ice samples analogous to our proposed volatile ice mixtures display an intriguing collection of absorption features in the ultraviolet. The experimental spectra corresponding to the two Trojan color groups show distinct shapes at these wavelengths. We propose using STIS to obtain UV spectra of the brightest 3 Trojans in each color subpopulation, as well as Patroclus, which will be visited by the upcoming NASA flyby mission Lucy. Finding spectral features in this data that match the laboratory spectra would not only confirm our hypothesis for the Trojan color bimodality, but also directly validate dynamical instability models of solar system evolution.
Double source plane (DSP) gravitational lenses are extremely rare alignments of a massive lens galaxy with two background sources at distinct redshifts. The presence of two source planes provides important constraints on cosmology and galaxy structure beyond that of typical lens systems by breaking degeneracies between parameters that vary with source redshift. While these systems are extremely valuable, only a handful are known. We have discovered the first DSP lens, the "Eye of Horus", in the Hyper Suprime-Cam survey and have confirmed both source redshifts with follow-up spectroscopy, making this the only known DSP lens with both source redshifts measured. Furthermore, the brightest image of the most distant source (S2) is split into a pair of images by a mass component that is undetected in our ground-based data, suggesting the presence of a satellite or line-of-sight galaxy causing this splitting. In order to better understand this system and use it for cosmology and galaxy studies, we must construct an accurate lens model, accounting for the lensing effects of both the main lens galaxy and the intermediate source. Only with deep, high-resolution imaging from HST/ACS can we accurately model this system. Our proposed multiband imaging will clearly separate out the two sources by their distinct colors, allowing us to use their extended surface brightness distributions as constraints on our lens model. These data may also reveal the satellite galaxy responsible for the splitting of the brightest image of S2. With these observations, we will be able to take full advantage of the wealth of information provided by this system.
Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15326
Program Title: Characterizing the Winds of M Dwarf Stars

Principal Investigator: Brian Wood
PI Institution: Naval Research Laboratory

We propose to use HST/STIS to study the H I Lyman-alpha spectra of ten very nearby (d<7 pc) M dwarf stars, to measure stellar mass-loss rates using the atmospheric absorption technique. The Lyman-alpha atmospheric absorption signature is currently the only means of detecting the coronal winds of cool main sequence stars, and HST is the only observatory that has ever been capable of observing it. Our goal is to use the absorption to study the winds of M dwarf stars, and for the first time characterize how these winds correlate with stellar activity, as quantified by X-ray luminosity. Atmospheric absorption has so far been observed for only one M dwarf (EV Lac), so our project will greatly increase our understanding of M dwarf winds. Our measurements will be compared with and test predictions for M dwarf wind behavior from theoretical/numerical models, and from studies of stellar angular momentum evolution. We will also investigate the implications that our measurements have for planets orbiting M dwarfs.
Proposal Category: GO
Scientific Category: Galaxies and the IGM
ID: 15356
Program Title: Probing Hell Reionization at z>3.5 with Resolved Hell Lyman Alpha Forest Spectra

Principal Investigator: Gabor Worseck
PI Institution: Max-Planck-Institut fur Astronomie, Heidelberg

The advent of GALEX and COS have revolutionized our view of Hell reionization, the final major phase transition of the intergalactic medium. COS spectra of the Hell Lyman alpha forest have confirmed with high confidence the high Hell transmission that signifies the completion of Hell reionization at z~2.7. However, the handful of z>3.5 quasars observed to date show a set of Hell transmission 'spikes' and larger regions with non-zero transmission that suggest Hell reionization was well underway by z=4. This is in striking conflict with predictions from state-of-the-art radiative transfer simulations of a Hell reionization driven by bright quasars. Explaining these measurements may require either faint quasars or more exotic sources of hard photons at z>4, with concomitant implications for Hi reionization. However, many of the observed spikes are unresolved in G140L spectra and are significantly impacted by Poisson noise. Current data cannot reliably probe the ionization state of helium at z>3.5.

We request 31 orbits to obtain science-grade G130M spectra of the two UV-brightest Hell-transmitting QSOs at z>3.5 to confirm and resolve their Hell transmission spikes as an unequivocal test of early Hell reionization. These spectra are complemented by recently obtained data from 8m telescopes: (1) Echelle spectra of the coeval Hi Lyα forest to map the underlying density field that modulates the Hell absorption, and (2) Our dedicated survey for foreground QSOs that may source the Hell transmission. Our recent HST programs revealed the only two viable targets to resolve the z>3.5 Hell Lyman alpha forest, and to conclusively solve this riddle.
Proposal Category: GO
Scientific Category: Planets and Planet Formation
ID: 15155
Program Title: Actively Disintegrating Asteroids around a White Dwarf

Principal Investigator: Siyi Xu

PI Institution: European Southern Observatory - Germany

Recent studies show that planetary systems can be widespread around white dwarfs. It has been proposed that planetary systems are responsible for the pollution observed in a white dwarf’s atmosphere and the excess infrared radiation. This scenario is greatly strengthened by the recent discovery of actively disintegrating bodies orbiting around the white dwarf WD 1145+017. In addition, this system has a heavily polluted atmosphere, a dust disk, and circumstellar gas. Our team has been monitoring this system since its discovery and our recent COS data have revealed many new surprises. We propose to continue studying this system for the next two cycles and further constrain the evolution of the disintegrating bodies: what are the main mechanisms responsible for its destruction? How is circumstellar gas produced and maintained?
Proposal Category: GO
Scientific Category: Solar System
ID: 15357
Program Title: Active Asteroid (3200) Phaethon during its unusually close approach to Earth

Principal Investigator: Quan-Zhi Ye

PI Institution: California Institute of Technology

The unusual asteroid and possible dormant comet (3200) Phaethon will pass 0.069 AU (27 lunar distances) from the Earth in Dec 2017, the closest since its discovery in 1983 and also until 2093. Phaethon is classified as an asteroid but has been associated with the strong Geminid meteor shower, implying significant mass loss during its previous orbits of which the mechanism remains poorly understood. We hereby request two HST GO orbits to observe Phaethon with HST/ACS during its flyby in Dec 2017. Our goal is to look for accompanying meter-sized fragments as well as to detect the associated dust (meteoroid) dust trail. The proposed observation will provide valuable information for the origin of Phaethon's mass loss. HST's high angular resolution and sensitivity is critical for achieving the maximum science return from this unprecedented close approach.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: AR  
Scientific Category: Galaxies and the IGM  
ID: 15059  
Program Title: Interpreting HST UV Spectra of Galactic Winds Using Radiative Transfer of Hydrodynamic Galaxy Simulations in yt

Principal Investigator: Hassen Yesuf  
PI Institution: University of California - Santa Cruz

Understanding gas in galaxies and its movement as galactic winds in particular is critical in galaxy formation and evolution studies. While enormous progress has been made in the last decade, the detailed properties (spatial distribution, ionization state, phase and kinematic structure) of gas in and around galaxies are still poorly constrained. HST observations have been instrumental in advancing the study of the complex multi-phase galactic winds. However, they have been interpreted using useful but simple wind models. With the advent of advanced high resolution hydrodynamic cosmological galaxy simulations, which claim to realistically model gas and metal distributions in galaxies and self-consistently generate winds, it is time to develop more sophisticated wind models to interpret the observations and also make simulation outputs into observable spectra. To that end, we propose to use the existing 3D radiative transfer (RT) wind model of Prochaska et al. 2011 to post-process the outputs from state-of-art hydrodynamic simulations. In addition to developing interpretive tools to study galactic winds, we will produce a large suite of synthetic mock HST UV spectra (including noise and instrument effects) for robust and unprecedented comparison between wind observations and theory. We will share our analysis tools and thousands of mock wind profiles and emission-line maps of varying galaxy properties, viewing angles, signal-to-noise and redshift with the community. Effort will be made to use machine-learning techniques to analyze these mock spectra. Finally, we will compare our analysis with other wind models that approximate the RT process and assess their accuracy.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Planets and Planet Formation  
ID: 15295  
Program Title: Revealing the birth environment of circumbinary exoplanets with STIS BAR5

Principal Investigator: Marie Ygouf  
PI Institution: California Institute of Technology

We propose to use four orbits of HST/STIS coronagraphy with the bent finger occulter (BARS) to image the circumbinary disk around the spectroscopic binary HD 34700. This disk was recently discovered by our team both with NICMOS and Keck-NIRC2 in the IR. We propose to probe it, for the first time in visible scattered light, down to as close as 0.2" (65 AU). HD 34700 has an eccentric 23-day orbit and may resemble the birth environment of circumbinary planets like the ones discovered by the Kepler mission. The eccentricity of the binary and the possible presence of additional companions make HD 34700 a unique testbed for studies of perturbed disk evolution. Previous observations by our team in the infrared show evidence for asymmetric features in both the inner and outer part of the disk. Possible interpretation is the presence of streamers and at least one spiral arm. New observations of this disk are required to confirm the nature and the cause of these features. Are they the result of stellar interactions, forming planets, or gravitational instabilities? We will probe the disk at high fidelity, with the goal of discriminating between these possibilities. We will look for signs of planet-disk interaction, with the aim to better understand the birth environment of dynamically extreme planetary systems. These observations are essential to unveil the very nature of this disk and will provide an anchor for future exploration with JWST and ALMA.
Cycle 25 Abstract Catalog
(Based on Phase I Submissions)

Proposal Category: GO
Scientific Category: Stellar Physics
ID: 15190
Program Title: Measuring the Intrinsic Lyman-alpha Profiles of High-Velocity G, K, and M dwarfs

Principal Investigator: Allison Youngblood
PI Institution: University of Colorado at Boulder

H I Lyman alpha (LyA; 1216 Å) is the brightest emission line in the UV spectrum of F-K dwarfs and is as bright as the rest of the entire 1150-3000 Å emission from M dwarfs. Stellar LyA emission plays a critical role in the chemistry of exoplanet atmospheres, energy transport in the stellar chromosphere, and in probing the density structure of the ISM. Thus, accurately characterizing LyA is critically important. However, interstellar H I removes more than 50% of the stellar LyA flux even for the nearest stars, necessitating reconstruction from the observed line profile wings and an assumption concerning the shape of the line core. The Sun (a G2 dwarf) is the only star for which we have high-resolution direct observations of the line core shape, which is self-reversed. Self-reversal in the LyA line core likely depends on spectral type, so incorrect assumptions of the line core shape for stars cooler or more active than the Sun will result in erroneous intrinsic LyA fluxes. We propose to directly measure with high spectral resolution (STIS E140M) the LyA line cores of five high radial velocity stars (G8 V to M4 V). These will be the first measurements of the LyA line with large Doppler shifts and sufficient resolution to probe the LyA line core shape. We will quantify the self-reversal depth, width, and symmetry, and compare amongst the spectral types. STIS E230H spectra will measure the Mg II line core shapes to test whether they are a good proxy for the LyA core shape. This program will create the first publicly available LyA intrinsic profile templates for late-type stars and update widely-used stellar LyA databases like the MUSCLES Treasury Survey.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category:    GO  
Scientific Category:  Galaxies and the IGM  
ID:                  15250  
Program Title:       Resolving the Multiphase ISM of an Elliptical Galaxy at z~0.4  

Principal Investigator:  Fakhri Zahedy  
PI Institution:  University of Chicago  

Nearly 40% of elliptical galaxies are found to contain cool gas but exhibit no on-going star formation, indicating that some feedback mechanisms are at work. While AGN feedback is commonly thought to be responsible for quenching star formation in massive halos, recent work has reiterated the importance of feedback from old stellar populations, including Type Ia supernovae (SNe Ia). In Zahedy et al. (2016), we reported detections of strong MgII absorption with rest-frame absorption equivalent width of Wr~4 Ang at two locations separated by 8 kpc in projected distance in the ISM of a z=0.408 massive elliptical. The most striking finding is a uniform, super-solar Fe/Mg ratio across a large line-of-sight velocity range of ~700 km/s. The observed super-solar Fe/Mg ratio suggests a large contribution of SNe Ia (>20%) in chemical enrichment. Follow-up low-resolution FUV spectroscopy with HST/STIS allowed us to measure a neutral hydrogen column density of log N(HI)~19.5 and metallicity of ~1/3 solar for both absorbers. Remarkably, the STIS spectra also revealed additional strong absorption features (Wr>1 Ang) that are consistent in wavelength with CII, CIII, NII, NIII, and OVI absorption lines, indicating the presence of a complex, multiphase ISM in this elliptical. Here we propose to use COS with the G130M and G160M gratings to spectrally resolve these low- to high-ionization lines in one absorber. The proposed high-resolution COS spectra will allow us to constrain both the column densities and velocity profiles of individual ions, providing a unique opportunity to resolve the thermal state and ionization condition in the ISM of an intermediate-redshift elliptical galaxy.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO 
Scientific Category: Galaxies and the IGM 
ID: 15121 
Program Title: Does Globular Cluster Formation Precede Galaxy Formation?

Principal Investigator: Dennis Zaritsky 
PI Institution: University of Arizona 

The recent findings that the number, or total mass, of a galaxy's globular clusters tracks the galaxy's total mass much more closely than it tracks the stellar mass suggest a decoupling of "early-phase" star formation (the globular clusters and perhaps halo stellar population) and the "late-phase" star formation (the central disk, bulge, and/or spheroid). Although these suggestive findings come from the study of normal, or high-surface brightness galaxies, the extreme example of this phenomenon is found in the ultradiffuse galaxy (UDG) DF 44. This galaxy is estimated to contain nearly 100 globular clusters, a similar number as in the Milky Way, but only 1% as many stars as the Milky Way. We propose to test this result with definitive data for DF44 and expand the sample of such galaxies by observing three other, spectroscopically-confirmed, physically similar galaxies at the same distance. These observations will confirm or refute the hypothesis that globular cluster formation is decoupled from galaxy formation as we envision it and that it precedes the formation of the central galaxy.
Cycle 25 Abstract Catalog  
(Based on Phase I Submissions)

Proposal Category: GO  
Scientific Category: Galaxies and the IGM  
ID: 15156  
Program Title: Mapping Gas Flows from the Disk to the Circumgalactic Medium

Principal Investigator: Yong Zheng  
PI Institution: Columbia University in the City of New York

The feedback efficiency in galaxies remains a crucial component in simulations that is not well constrained by observations. To understand how effectively feedback drives metals into the circumgalactic medium (CGM), we propose to map the metal flows from the disk to the CGM of the nearby dwarf irregular galaxy IC 1613. This will be the first spatial and kinematic map of gas flows from the disk to the halo of a dwarf galaxy. In archival COS spectra of two IC 1613 stars we detect blue-shifted SilI, CII, and SiIV absorption lines, indicative of the existence of multiphase outflows from the disk. We propose to observe two more UV bright stars in IC 1613's disk to assess the covering fraction and strength of the outflow in relation to the galaxy's resolved star formation. We will also observe three QSO sightlines at 0.1, 0.3, and 0.5 Rvir to measure the ionization profile of the gas and the extent of the outflows. We will relate our measurements to the detailed observed star formation history of IC 1613 to directly determine the mass loading factor and feedback efficiency. The proposal will provide critical information on how galaxies evolve and how metals circulate between the disk and the CGM.
Proposal Category: AR
Scientific Category: Planets and Planet Formation
ID: 15060
Program Title: Unleashing the Charges: An Improved Reduction of Key Exoplanet Datasets and a Tool for Ramp Effect Correction

Principal Investigator: Yifan Zhou
PI Institution: University of Arizona

Among HST's most lasting and iconic results are WFC3/IR observations of transiting exoplanets that provided exciting insights into atmospheres of planets ranging from super-earths to hot-Jupiters. However, all time-resolved WFC3/IR observations suffer from an often-limiting detector systematic: the "ramp effect." Current efforts are forced to discard orbits most affected and to apply an empirical procedure to minimize the amplitude. We developed and demonstrated a powerful new, solid state physics-motivated detector model that accurately corrects for the ramp effect and reaches essentially photon-noise limited performance for even the most affected orbits. We propose here to apply our RECTE ramp charge trap correction to key archival datasets for which significant improvements are expected. We will also use these datasets to further test and document the RECTE correction on data acquired in different observing modes and to seek further improvements in RECTE's detector parameters. We will document and release RECTE, along with a data reduction cookbook, to the community. We also expect important improvements in the science results from the four key HST datasets.

Our charge trap correction will help increasing HST's efficiency for infrared transit spectroscopy by about 20-25% (no more need to discard first orbits), saving dozens of orbits in the future, and will also improve the reliability and reproducibility of infrared time-domain observations. Our work is especially important for the most challenging transit and phase curve observations and will likely provide an example for an approach that can be utilized for JWST instruments with architectures similar to WFC3.